PB-214 942

PACIFIC NORTHWEST DRAINAGE BASINS: A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION

Public Health Service
Cincinnati, Ohio

1951

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Water Pollution Series, No. 6

PB 214 942

For Clean Water—"One River, One Plan"

Pacific Northwest
DRAINAGE BASINS

A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION

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FEDERAL SECURITY AGENCY

Public Health Service

94

SUMMARY REPORT ON WATER POLLUTION

Pacific Northwest Drainage Basins

Prepared by

FEDERAL SECURITY AGENCY
Public Health Service
Division of Water Pollution Control
Pacific Northwest Drainage Basins Office

1951

In cooperation with:

Idaho State Department of Public Health
Montana State Board of Health
Oregon State Sanitary Authority
Washington State Pollution Control Commission
Wyoming State Department of Public Health

I

Public Health Service Publication No. 87

WASHINGTON: 1951

II

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June of 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary conditions of surface and underground waters.

In developing these programs, due regard must be given to improvements necessary to conserve the Nation's waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, industrial, and other legitimate uses.

Recognizing the fact that full technical information was not available to permit the development of such comprehensive programs immediately for most of the Nation's waters, the Public Health Service envisioned the development of these programs in two general phases. The first phase contemplated the development of a series of reports, consistent with presently available data, which would: provide a reference point for measuring progress; provide a guide to needed additional data; provide a basis for the logical development of comprehensive programs; provide a basis for approval of loans to States, interstate agencies and municipalities at such time as the Congress made available funds for this purpose; and serve to inform the public on the problem of water pollution and set forth suggestions for pollution control.

The collection of available data as of July 1, 1950, has been completed under the first phase of the program. Such data have been assembled with the cooperation of State and interstate water pollution control agencies. Through these agencies additional data have been obtained from other State officials, county and city officials and representatives of industry. Federal agencies also have been of great assistance. In order to make this information available at the earliest possible moment, these data are being presented in 15 summary-type reports covering the United States by major drainage basins. This report on the Pacific Northwest Drainage Basins is one of that series.

These summary reports present information about the ways our water resources are used, the pollution going into our water resources and the resulting damages, the benefits which may result from pollution prevention and abatement, the pollution prevention measures now in effect, and those required.

They are prepared in two parts. Part one considers the water pollution problems of the basins as a whole. Part two presents briefly the data for each of the several subbasins of the major basins, including a list of projects now known to be needed for water pollution control.

Since the summary reports are based on data which are now readily available, these reports do not discuss or evaluate the most advantageous water uses as they are related to pollution control. Such considerations will be included as a part of the comprehensive water pollution control programs.

The deficiencies in data and the gaps in information indicated in these summary reports are as significant as the presentation of available facts and statistics. They indicate the work which still needs to be accomplished by water pollution control authorities for the preparation of comprehensive programs.

Data and knowledge now available are sufficient, however, to permit the immediate solution of many of the polution problems within the Pacific Northwest Basins without awaiting the results of additional surveys and studies. The tabulations of pollution abatement projects which are included in Part Two of this summary report represent presently known needs. However, future studies and evaluations may result in some changes in the estimations of requirements.

A sincere effort has been made by all who contributed to this report to present a fair picture of the complex water pollution problems in the Pacific Northwest Basins and to present reasonable conclusions and recommendations. It is our hope that this report, as a step in the cooperative development of an ultimate comprehensive pollution control program, will help in safeguarding the water resources of the Pacific Northwest Drainage Basins.

Leonard A. Scheele

Surgeon General

ACKNOWLEDGMENTS

The Public Health Service wishes to acknowledge the full cooperation received in the preparation of this report from the following interested agencies of the States of Idaho, Montana, Oregon, Washington, and Wyoming: Idaho (Department of Public Health, Water Resources Advisory Committee, Fish and Game Commission, Department of Reclamation, Mining Association); Montana (Board of Health, Water Conservation Board, Fish and Game Commission, Livestock Sanitary Board); Oregon (Sanitary Authority, Board of Health, Fish Commission, Game Commission, Office of State Engineer); Washington (Pollution Control Commission, Department of Health, Department of Fisheries, Department of Game, Department of Conservation and Development), and Wyoming (Department of Public Health).

Information obtained from the Nevada and Utah State Departments of Health indicated that no significant amounts of pollution were entering Pacific Northwest watercourses from these two States.

Federal agencies from which assistance was obtained include: Corps of Engineers, Department of the Army; Forest Service and Soil Conservation Service, Department of Agriculture; Bureau of the Census, Department of Commerce; and Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, and the Bonneville Power Administration, Department of the Interior.

Finally, there is acknowledged the assistance of other State agencies and individuals interested in water resources development and conservation, who have contributed information through other sources than those listed above.

SUMMARY

The Pacific Northwest Drainage Basins, exclusive of the Canadian drainage area, include the Columbia River Basin, Puget Sound Basin, the Oregon and Washington coastal areas, and the Southern Oregon Lakes area. Roughly, they embrace the State of Washington, the greater part of Oregon and Idaho, western Montana, and small parts of Wyoming, Utah and Nevada. The total land area in the United States portion of the drainage basins is 274,000 square miles.

The estimated 1950 population is 4,600,000, an increase of 31 percent over that reported by the 1940 census.

Economic development of the Pacific Northwest has increased greatly during the past decade and is continuing at a rapid rate. Low cost hydroelectric power developed in large plants on the Columbia River and in the smaller plants of the Puget Sound Basin area have been mainly responsible for the tremendous industrial expansion.

The natural resources of the Pacific Northwest include its waters, agricultural lands, forests, mineral deposits, and its abundance of fish and wildlife. About 40 percent of the remaining timber supply of the United States is located in the Pacific Northwest. Consequently, the area supports many large lumber, pulp and paper, and other wood products industries.

Agriculture is the leading industry. The more than 4,000,000 acres of irrigated agricultural lands together with extensive range lands and dry-farmed areas are directly and indirectly responsible for providing a major portion of the area's employment possibilities.

The world's largest silver, lead, and zinc mines are located in the area. Aluminum reduction mills produce from raw materials transported into the area nearly 50 percent of the Nation's aluminum.

The Hanford Atomic Energy plant built during World War II and the Arco, Idaho, plant now under construction are other large industrial developments utilizing the hydroelectric power and abundant water supplies of the Pacific Northwest.

The economy of the area is dependent primarily on the use of its water resources for domestic, industrial and agricultural water supplies, hydroelectric power, transportation, commercial fishing, and recreation. These water resources are estimated to have an average annual yield of 280,000,000 acre feet. Many of the basins' streams are snow-fed and contain sparkling clear water throughout their courses. Others show the effects of soil erosion and industrial and domestic pollution.

Major pollution of the basins' watercourses is caused by the discharge of sewage and industrial wastes from 434 municipalities, with a total sewered population of about 2½ million people, and from 824 industrial plants that discharge wastes directly to the watercourses. Based on information available, 400 of the municipalities and 211 of the industries, are known to discharge an organic pollution load having a population equivalent of approximately 16,000,000. These 211 industries contribute about 82 percent of the total known organic wastes discharged to watercourses. In addition, inorganic wastes are discharged by 117, or more, industries.

The principal inorganic industrial wastes discharged to watercourses are from metal planting plants, ore concentration mills and smelters, aluminum reduction mills, and coal and gravel washing plants. In a number of locations these wastes are toxic to fish and other aquatic life, endanger livestock and wildlife, restrict recreational uses of the waters, and detrimentally affect domestic and industrial water supplies.

Probably the greatest stream degradations to be found in the area result from the discharge of acid mine wastes and tailings from ore concentration mills. These wastes contain chemicals which are detrimental to normal water uses, and they cause depositions which destroy aquatic life in the stream. More than 100 miles of watercourses in the Pacific Northwest have been degraded in this manner.

Although the organic waste load carried by watercourses is great, the steep gradients, the high falls and large flows which occur in most of the streams make possible a rapid natural stream recovery which is important in the stabilization of the wastes. Even with this great natural recovery potential, however, some of the larger watercourses have become dangerously polluted. In areas where pollution damages from organic wastes have occurred or are now existing, abatement programs are well underway. The Willamette River Basin in Oregon is an example of this. In this basin the discharge of organic wastes equivalent to the wastes from about 4 million people has retarded the full development of the river's fishery potential, destroyed recreational areas, decreased waterfront property values, and seriously impaired the quality of present and future water supply sources.

Another example of serious pollutional damage is found in the Puget Sound Basin in

Washington. The discharge, into the tidal waters, of raw sewage from municipalities and industrial wastes from pulp and paper mills, chemical and metal plating plants, and a variety of other industries is creating conditions that are dangerous to health, and are destructive to an extensive fishery. This pollution also is depreciating waterfront property values and spoiling recreational attractions of an area that caters to millions of tourists annually. The pollution effect of the wastes discharged to the waters of the Puget Sound Basin is comparable to that of the wastes from more than 6 million people.

In the populated valleys of the Upper and Central Snake River Basins in Idaho and the Yakima River Basin in Washington, unusually high rates of enteric diseases have, for many years, been reported during the late summer and fall months. It is believed by public health officials that a contributing factor in these outbreaks is the use, on thousands of acres of land, of irrigation water polluted with raw and partially treated municipal sewage.

Several excellent shellfish growing areas in Puget Sound and along the Washington and Oregon coasts have been contaminated by bacterial pollution. These areas, now closed to commercial fishermen, represent a considerable monetary loss to the Pacific Northwest.

The Columbia River is the boundary between Oregon and Washington for more than 300 miles before reaching the Pacific Ocean. The principal tributaries in the upper watershed feeding the Columbia cross State and international boundaries before emptying into it. Both interstate and international pollutional problems exist in the Pacific Northwest. The extent of interstate pollution damages has not been fully determined, but is believed to have caused a considerable monetary loss to the fishery industry and to have increased treatment costs for those municipalities and industries using these waters for domestic and industrial processing purposes.

Benefits resulting from pollution abatement in the Pacific Northwest have been largely of a local nature; however, some have been basin wide. The outstanding example of the former is the restoration of the great Olympia oyster industry on Puget Sound which has been brought about by the conversion of a pulp mill at Shelton, Wash., to the ammonia base process and the installation of equipment for burning of waste sulphite liquor. Other benefits to the fishery resources have been realized from ponding of wastes by a pulp mill at Hoquiam, Wash., and the use of recovered wastes for production of alcohol by a pulp mill at Bellingham, Wash.

The construction of sewage treatment plants by 15 of the 17 sewered communities of the Yakima River Basin has improved the quality of the water used for irrigation and rural domestic purposes and has provided greater protection for the health of many people residing within this basin.

Localized in effect but of importance to future pollution abatement progress is the magnesium base sulphite pulping process installed by a pulp mill located on the Columbia River at Longview, Wash. Pollutional wastes from this process are but a fraction of those from other pulping processes. From all indications, other pulp mills may be able to use this process and recover chemicals and heat sufficient to pay for construction, operation, and maintenance costs of the process. In addition, a modest profit may be realized as the process is perfected. This improved pulping process may become an effective pollution abatement measure.

Although more than 1,200 municipal and industrial sources of pollution exist in the Pacific Northwest, less than one-third are known to be provided with waste treatment facilities. Only 132 of the 377 existing treatment plants are providing adequate treatment of the wastes. Information on municipal and industrial treatment facilities is summarized in tables 1 and 2.

Municipal sewage treatment plants have been constructed at 229 locations. They serve about 600,000 people or 25 percent of the total sewered population of 2½ million. Adequate sewage treatment in known to be provided at 121 plants serving about 377,000 people, or about 15 percent of the total sewered population. The capacity of 86 plants is inadequate and adequacy as to capacity of the remaining 21 plants has not been determined. There are 182 municipalities, with sewer systems serving a total population of over 1,800,000, which at present have no waste treatment facilities.

Industrial waste treatment facilities are known to be provided at 148 industries. The adequacy of capacity at 132 of these plants has not been determined. Only 11 are known to be adequate and 5 are known to be inadequate. Whether waste treatment facilities exist at an additional 481 industries has not as yet been determined.

The present municipal sewage treatment program, including the 22 plants now under construction, requires a total of 331 projects estimated to cost $93,294,000, Fifty-seven of these projects will replace and 43 will enlarge existing facilities. The remaining 231 projects will be new treatment plants. Upon completion of the necessary construction, adequate sewage treatment facilities will be provided for about an additional 2,000,000 people now living in the Pacific Northwest. The above estimate does not include the cost for treatment projects at 24 municipalities where needs have not been determined.

Of the 331 municipal waste treatment project requirements, 15 are for cities having over 20,000 population, 4 of which have populations over 100,000 and one has a population of 410,000. One hundred and sixteen of the projects are for cities having populations between 2,000 and 20,000 while 200 are for cities with populations under 2,000. Of the latter one hundred and thirty-nine have populations of under 1,000. Also, of the total municipal waste treatment project requirements, 71 are for presently unsewered communities which have a total population of about 146,000.

The present industrial waste treatment program includes a total of 67 projects estimated to cost $29,765,000. This program is based on present knowledge of industrial waste treatment needs and does not include the requirements of 699, or 85 percent, of the industrial plants known to be discharging wastes directly to public waters. Included in the 67 projects, however, are 9 sulphite pulp mills discharging wastes with a total population equivalent of 8,000,000. These 9 plants are under orders to abate pollution by 1952. Pollution abatement by these pulp mills will reduce the total known organic industrial wastes discharged to watercourses in the Pacific Northwest by about 42 percent.

Based on 1950 costs, the present known municipal and industrial treatment needs are estimated to require a total expenditure of $123,059,000. This includes the estimated cost of the waste treatment plants now under construction. Not included in these estimates is the cost of operating and maintaining the the facilities after construction.

TABLE 1 - Summary of municipal treatment plant data

Basin	Population served by sewers	Number of municipalities with sewers	No. of municipalities with --			Population served by adequate treatment plants	
			Treatment plants	Adequate treatment plants	Adequacy of plants undetermined	Number	Percent of total sewered population
Kootenai	4,260	3	2	0	1	0	0
Clark Fork - Pend Oreille .	121,461	28	11	0	6	0	0
Spokane	180,874	22	7	7	0	15,417	8
Yakima River .	89,495	17	15	10	0	77.227	86
Columbia R. Basin above Yakima River	51,744	30	25	16	1	25.674	50
Upper Snake R. Basin	72,888	21	10	4	1	8.300	11
Central Snake River Basin ..	68,350	22	12	3	1	38.250	56
Middle & Lower Snake R. Basin	62,673	29	15	4	1	20.450	33
Willamette River Basin ..	519,150	50	30	19	0	24.600	5
Columbia R. Basin below Yakima River .	250,790	48	30	18	0	16.255	6
Puget Sound Basin	908,239	92	48	29	7	115,416	13
Wash. Coast Basin	56,219	12	5	1	1	5,000	9
Oregon Coast Basin	76,695	38	17	9	2	27,750	36
Southern Oreg. Lakes Basin ..	2,500	2	2	1	0	2,300	92
Total.....	2,465,338	414	229	121	21	376,639	15

TABLE 2 - Summary of industrial treatment plant data

Basin	Number of industries	Existence of treatment facilities undetermined	Number of industries with --		
			Treatment plants	Adequate treatment plants	Adequacy undetermined
Kootenai River.....	4	4	0	0	0
Clark Fork-Pend Oreille River.....	27	11	2	0	1
Spokane River	53	13	9	1	8
Yakima River	37	20	11	0	11
Columbia River abo e Yakima River.....	39	28	10	0	10
Upper Snake River.....	25	14	0	0	0
Central Snake River....	31	10	6	0	6
Middle & Lower Snake River	21	16	5	0	5
Willamette River.....	89	17	50	0	49
Columbia River below Yakima River.....	119	104	13	9	4
Puget Sound	280	167	38	1	37
Washington Coast.....	59	56	1	0	0
Oregon Coast	40	21	3	0	1
Southern Oregon Lakes	0	0	0	0	0
Total	824	481	148	11	132

Additional survey data are needed to complete the necessary information on water pollution in the Pacific Northwest. In spite of the lack of specific pollution data for many of 434 municipalities and 824 industries, those for which measured or estimated waste discharges are available represent a large part of the area's total pollutional load. Sufficient knowledge is now at hand to form the basis of a much needed initial comprehensive water pollution control program. It can be expanded and modified as more precise data become available. In this connection, surveys are needed to determine the volume and strength of wastes from some 213 industries connected to city sewers and 613 industries with separate discharge outlets.

Continued cooperation among municipalities, industries, and State and Federal agencies will facilitate carrying out action programs to restore and protect the water resources by the prevention and abatement of pollution.

In the States of Idaho and Montana existing laws are inadequate for the control of water pollution. In these States no single agency is responsible for carrying out the provisions of such laws as at present pertain to water pollution. Instead in each State the responsibility rests with a number of agencies to administer these laws. As a result, it is impossible to establish and administer a comprehensive water pollution control program.

CONCLUSIONS

1. Population growth and industrial expansion in the Pacific Northwest are closely related to the development of the area's extensive water resources.

2. Water pollution resulting from an increasing population and expanding industry has caused a great deal of damage to the water resources in the Pacific Northwest. Pollution damages have been particularly severe in the Upper Clark Fork, the Coeur d'Alene, the Yakima, the Snake and the Willamette Rivers, in Puget Sound; and in a number of other watercourses. Pollution problems of a potential interstate or international character have developed along the Columbia, the Pend Oreille, the Spokane and the Snake Rivers.

3. The anticipated population growth and industrial expansion which will result from the multiple-purpose projects for the storage of irrigation waters and development of hydroelectric power now under construction or authorized necessitate that immediate pollution control action be taken to conserve the Pacific Northwest's water resources.

4. Financial assistance to municipalities for the preparation of preliminary engineering reports, final construction plans, and construction of waste treatment facilities would greatly accelerate present pollution control programs.

5. Industry should accept responsibility for correlating and disseminating information on industrial waste prevention, recovery, and treatment methods. Industry also should stimulate research for the development of new and improved methods of treating those wastes for which effective treatment has not been developed or is excessively costly for individual industrial plants.

6. More adequate water pollution control legislation is needed in Idaho and Montana. Additional technical personnel are needed by the water pollution control agencies of all the Basin's States in order effectively to implement comprehensive abatement programs.

7. Additional survey data are needed to determine the treatment requirements for 24 municipalities and 699 industries. The State water pollution control agencies have already evaluated the treatment needs for 331 municipalities and 67 industries.

8. Nearly 45 percent of the municipalities for which treatment requirements have been determined have projects either under construction, being planned or awaiting financing. Orders to abate pollution by 1952 have been issued to 19 of the larger industrial pollution sources.

9. Excessive silt loads and logs, bark and other debris in streams, resulting from improper management of agricultural and forest lands, are increasing the cost of water treatment, blocking the migration of anadromous fishes, clogging navigation channels, creating local flood conditions, and impairing the ability of streams to recover from waste pollution.

10. Greater coordination of the activities of all concerned in the planning of water resource developments—State and Federal agencies and industries—will materially aid in solving future water pollution problems in the Pacific Northwest.

RECOMMENDATIONS

From a consideration of all available information, including the program plans of State Water Pollution Control Agencies and other State and Federal agencies, which have served as a basis for this report on water pollution in the Pacific Northwest Drainage Basins, it is recommended that:

1. The 331 municipalities and the 67 industries for which project needs have been determined initiate action to provide adequate waste treatment facilities.
2. All industries discharging wastes causing or tending to cause pollution initiate waste prevention and/or recovery measures and provide waste treatment facilities where necessary.
3. The States, and through the States, the Federal Government assist in every way possible those municipalities and industries now proceeding with the planning or construction of waste treatment facilities so that pollution abatement program schedules may be maintained.
4. The States of Idaho and Montana enact adequate water pollution control legislation. Such legislation should invest responsibility for its administration in a single State agency.
5. The States appropriate sufficient funds to enable their water pollution control agencies to expedite the surveys and studies necessary for determining:

   a. the sources, characteristics and volumes of all municipal and industrial wastes,

   b. the quality of the Basins' waters below sources of pollution, and

   c. the treatment needs for municipal and industrial sources of pollution.

6. Uniform standards of water quality for all water uses be established and adopted by State pollution control agencies.
7. Uniform sewage works design standards and regulations for industrial waste prevention and treatment be developed by State pollution control agencies.
8. State water pollution control agencies develop programs for the improvement of waste treatment plant operations and that they expand their current activities for the training of plant operators.
9. The States concerned engage in joint pollution surveys of streams where interstate and international pollution problems exist. Such streams include: the Pend Oreille and Columbia River above and below the international boundary; the Spokane River in Idaho and Washington; the Snake River above and below Lewiston, Idaho; the Snake River along the boundary of Idaho and Oregon, below Nyssa, Oreg., and the Columbia River below the Hanford Atomic Energy plant and along the boundary of Oregon and Washington to its mouth.
10. Soil conservation and flood control programs of State and Federal agencies be carried on more vigorously in order to reduce silt loads in streams and the resulting depositions which now occur during floods.
11. Water pollution control be made an integral part of all water resource development studies and plans for the Pacific Northwest.

GENERAL DESCRIPTION

Historical Background

Prior to settlement by white men, the Pacific Northwest was occupied by numerous Indian tribes of three principal groups or families: the Shoshones, the Shapatian and the Salishan. Descendants of these Indians now occupy limited areas of the basin which are reserved for them.

Though the shores of the Pacific Northwest were visited by earlier explorers, it was the American, Captain Gray, who first entered the Columbia River and it was for his ship that the great river was named. A few years later, in 1805, Lewis and Clark carried out their historic exploration of the Columbia River territory. For the next half century the region was dominated by the fur-trading activities of the Hudson Bay Company. As a result of Lewis and Clark's exploration, however, American settlers began to arrive in increasing numbers and the fur trade was eventually forced to give way to agriculture and other pursuits. The discovery of gold in the west contributed greatly to further economic development. The tremendous natural resources of the Pacific Northwest have created the vigorous economy which is now typical of the area and insure its continued development.

Physical Description

The Pacific Northwest Drainage Basins include the Columbia River Basin, the Puget Sound Basin, the Oregon and Washington coastal areas, and the southern Oregon Lakes area. The various drainage basins cover, roughly, the State of Washington, the greater part of Oregon and Idaho, western Montana and small parts of Wyoming, Utah and Nevada.

The greater part of the region is mountain or plateau and contains five important and relatively distinct major mountain masses, all extending in a general north and south direction. These are: the Rocky Mountain ranges and spurs in western Montana and Wyoming; the extensive associated mountain masses reaching through central and northern Idaho and along the Montana border, and embracing the Sawtooth, Salmon River, Bitterroot, Coeur d'Alene, Selkirk and other ranges; the Blue and Wallowa Ranges in eastern Oregon and Washington; the Cascade Range in west-central Oregon and Washington; and the Coast and Olympic Ranges in western Oregon and Washington. The higher peaks in the Montana and Idaho mountains are between 12,000 and 13,000 feet in elevation. In the Blue Mountain group the peaks average from 6,000 to 10,000 feet; in the Cascades, from 10,000 to 14,000 feet; and in the Olympics from 7,000 to 8,000 feet. The plateaus, which cover a considerable part of the total basin area and are cut in many places by traversing streams in deep gorges, generally range in elevation from 2,000 to 5,000 feet.

In various parts of the region wide mountain valleys and intermountain basins occur at elevations ranging from a little above sea level to 4,000 feet. These are the Puget Sound area in Washington, the Willamette valley in Oregon; the Columbia Basin valleys in Washington and Oregon; the Snake River valleys and plains in Washington, Oregon and Idaho; and the Clark Fork valleys in Montana.

All of the higher mountainous areas and the greater part of the area west of the Cascades are forested, while the plains and plateaus east of the Cascades have a normal cover of native grasses and brush common to the arid and semi-arid areas of western America.

Extremely wide variations in climatic conditions exist, due primarily to the influence of mountain ranges and of elevation. West of the Cascades, under marine influences, the climate is relatively mild, equable and humid, although the summers are dry. Climate east of the Cascades is more continental in character.

West of the Cascades precipitation varies from about 40 inches annually in the valleys to 100 inches or more in the mountain areas. Extremes in limited lowland areas range from 15 to 30 inches, while in some small mountain areas over 200 inches of rain and snow fall annually. Precipitation east of the Cascades varies from about 6 inches in sheltered basins to 50 inches or more in high mountain areas. In the high mountain masses snowfall makes up a greater part of the precipitation.

Temperature extremes vary from about 10 to 100 degrees F. along the coast to minus 50 and 120 degrees F. in some of the central valley plateaus.

The total land area in the United States portion of the Pacific Northwest Drainage Basins is 274,000 square miles. The Columbia River drainage area alone includes 220,000 square miles in the United States plus an additional 39,000 square miles in British Columbia.

The estimated 1950 population of the Pacific Northwest Drainage Basins is 4,600,000. This

represents about a 31 percent increase in population since 1940.

Economic Development

Prior to World War II economic development in the Pacific Northwest Basins was somewhat below that of other regions of equal population, During and since the war, however, the trend has been toward industrial development and the expansion of irrigation. Although manufacturing of finished products still remains at a somewhat low level, the production of partly processed commodities has increased tremendously.

The most important natural resources of the Pacific Northwest are its waters, agricultural lands, forests, mineral deposits, fish and game. The economy of the area depends heavily upon use of its water resources for hydroelectric power, transportation, commercial fishing, recreation, domestic, industrial and agricultural purposes including the irrigation of about 4 million acres of land.

Probably the greatest factor influencing the industrial and economic growth in the Pacific Northwest has been the development of hydroelectric power. The Bonneville Power Project completed in 1943, and the Grand Coulee Project, now nearing completion, along with a number of municipal and privately owned power developments constructed since the war have more than doubled the capacity of hydroelectric power generating facilities in the Pacific Northwest. The present installed capacity of hydroelectric generating facilities is 4,176,600 kilowatts. Potential power developments include more than one-third of the Nation's total estimated hydroelectric power potential.

The extractive industries--agricultural, lumbering and mining--and related processing and manufacturing enterprises have greatly expanded because of low cost electric power and water for irrigation made available by the construction of multiple-purpose storage reservoirs.

Agricultural cropland includes only about 10 percent of the basins' area, but extensive range and pasture lands (involving about two-thirds of the area) in conjunction with complimentary irrigated areas producing stock feed, are very important to the region's economy. Irrigation projects now under development will cause the economic value of this industry to increase even more rapidly during the next decade.

The Pacific Northwest States contain over 700 billion board feet of timber, about 40 percent of the remaining timber supply of the United States. They furnish about one-third of the lumber produced in the Nation. About 15.5 billion board feet of lumber were harvested during the last year of record. Forest areas, together with interspersed portion of range areas, include the principal water sources of the river systems. Indiscriminate cuttings in watersheds where some domestic and agricultural water supplies are obtained have affected the quality of water for these uses and reduced watershed values.

Known occurrences of valuable minerals are widely distributed throughout the Pacific Northwest. The geologic structure is favorable to ore-formation in large areas in Idaho and western Montana and in various parts of Washington and Oregon. The largest silver, lead and zinc mines in the World are located in the area. Two of the mining districts, Butte, Mont. and Coeur d'Alene, Idaho, have each produced more than one billion dollars worth of mineral wealth, a record achieved by only six other mining districts of the world. This production will continue, as known reserves of ore are relatively very large. The Metaline Falls district in northeastern Washington is becoming an important producer of zinc and lead.

Considerable amounts of coal are mined in the Puget Sound, the Washington Coast, and the Yakima Basins. The Pacific Northwest Basins also produce most of the vermiculite mined in the United States and have produced notable amounts of gold, copper, manganese, tungsten, cadmium, bismuth, magnesium, antimony, arsenic, phosphates and mercury.

The milling, reduction and refining plants are also notable for their size. Large smelters are located at Anaconda, Mont., and Kellogg, Idaho, close to the mining districts; however, large quantities of partially processed minerals are shipped to Tacoma, Wash., for smelting and further processing in that area. Aluminum reduction mills, that were located in the Pacific Northwest during World War II to utilize large blocks of hydroelectric power available at the time, are now producing nearly 50 percent of the aluminum. Raw materials used in the production of aluminum are transported into the area.

The natural resources of the Pacific Northwest provide most of the raw materials used in the manufacturing that is carried on in the area. Since 1940, however, the availability of low cost hydroelectric power, the development of new process techniques, and the impetus of war-expanded markets have resulted in a much broader pattern in manufacturing. Additional expansion of industry undoubtedly would be extensive, if the available power supply were not already overtaxed. Power shortages have occurred each year since the world War II and have necessitated a limitation on hydroelectric power that can be used by new industrial processing plants desiring to locate in the area.

Two rolling mills located at Seattle and one at Portland produce steel ingots from scrap

LOCATION MAP

Pacific Northwest Drainage Basins

2-a

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iron. Expanded steel production in the area is dependent upon ore and development of a power supply for electric furances.

Two atomic energy plants are located in the Pacific Northwest. The one located at Hanford, Wash., was built during World War II. The second plant located at Arco, Idaho, is now under construction.

The exportation of raw materials and partially processed commodities and the importation of manufactured goods characterize the trade of the region. Adequate facilities are available for transportation by rail, highways, air, and ocean and inland waterways. Excellent harbor facilities and the low cost hydroelectric power available at most major cities have been instrumental in bringing about the tremendous industrial development that occurred during the last decade. Ocean-going vessels utilize the Columbia River upstream to The Dalles, Oreg., and barges travel upstream to Pasco, Wash., more than 300 miles above the Columbia's mouth.

The commercial fishery industry of the Pacific Northwest is of great importance to the economy of the area. This industry's capital investment in fishing equipment, boats, and packing plants is estimated to be in the neighborhood of 200 million dollars. Data are not available for the Pacific Northwest as a whole, but according to the Washington State Department of fisheries the wholesale value of fish, fish products and by-products, plus the money paid Washington fishermen for their catch during 1949, is estimated to be 100 million dollars. The commerical fishing industry is supported principally by five species of salmon--the Chinook or King, silver, sockeye, pink and chum--and many types of ocean food fishes. The shellfish industry also represents an important part of the fishing industry.

In former studies of the economic wealth of the Pacific Northwest recreation has not always been considered as a major industry. The actual number of people this industry supports and the number who partake of the recreational opportunities in the area are not known. It has been estimated by State agencies and others concerned, however, that tourists spent over 300 million dollars in the Pacific Northwest during 1949. Not included in this total is the money spent for recreational purposes by local residents.

A combination of ideal year-round climate, unsurpassable scenery, and exceptional recreational opportunities make the Pacific Northwest popular with summer vacationists, winter sports enthusiasts, hunters and fishermen.

USES OF WATER RESOURCES

The annual water yield of all river systems in the Pacific Northwest is estimated at 280,000,000 acre feet. Of this total the Columbia River system is estimated to contribute about 64 percent, or 180,000,000 acre feet. About 15 percent of the total area drained by the Columbia River is in Canada, and yields roughly 35 percent of the total runoff of the Columbia River system. The total runoff represents about two-thirds of the annual precipitation over the area. Runoff per unit of area west of the Cascades is three to four times greater than that of the eastern slopes.

Ground waters, although in general of less importance than the surface waters in the Basins, have a high actual and potential value in a number of localities.

The water resources of the Pacific Northwest Basins are used for water supply (domestic, industrial, and agricultural), propagation of fish, support of wildlife, recreation, navigation, and hydroelectric power development.

Domestic Water Supply

About 2 million persons located in 311 cities, towns and other areas served by water systems obtain all or a major portion of their drinking water from surface sources. The demand on surface water resources for domestic use is estimated to average 250 million gallons daily. Another 3/4 million persons supplied by 409 water systems using ground water sources are estimated to use about 100 million gallons daily. These estimates include the amount of water used by industrial plants served by domestic water supply systems. During the summer months the demand on these water resources is about 3 times that of other seasons of the year.

Most of the surface supplies are obtained from high mountain forested areas, are adequate in quantity, soft and usable without extensive treatment. There are exceptions, however, in localities where indiscriminate logging of the watersheds has changed the character of the runoff and has affected the water quality. As a result of pollution, a number of communities have had to abandon sources of water supply near at hand and spend considerable sums of money to obtain domestic supplies from unpolluted sources located in the higher mountain forested areas. Others have had to bear increased water treatment costs or have had to develop ground water supplies.

Industrial Water Supply

Many industrial plants using relatively small quantities of water depend upon public water systems to supply their needs. Others, particularly those requiring large quantities of water or those located outside the area served by the public systems, have developed their own supplies. With few exceptions, these private supplies are obtained from adjacent surface or underground sources. However, some industries have had to resort to treatment of the polluted river waters.

It is estimated that the total average daily industrial water demand in the Basins is about 1-1/4 billion gallons. Approximately 80 percent of this total is obtained from surface sources.

Water supplies for industrial use are adequate throughout most of the area. Most surface waters can be adequately treated to provide a satisfactory quality for industrial use.

Agricultural Water Supply

About 4,000,000 acres of land are irrigated in the Pacific Northwest. Proposed developments by the Bureau of Reclamation and the Corps of Engineers would more than double this irrigated acreage and in addition would provide supplemental water supplies for 1,570,000 acres. Existing artificial storage facilities in the area have an active capacity of over 14 million acre feet. Potential developments for irrigation, flood control, navigation and power will increase this storage capacity by more than 27 million acre feet.

In highly developed irrigation areas, such as the Yakima River Valley, the Upper Snake River Valley and the Central Snake River Basin, where most of the stream flow is used during the latter part of the irrigation season, the disposal of domestic sewage and industrial wastes is a problem. The rapid growth of population in these areas which do not have adequate facilities for treatment of domestic sewage and industrial wastes has resulted in serious pollution of waters diverted for irrigation and other rural uses. In parts of the Yakima and Central Snake River Basins polluted irrigation water is spread over the land with subsequent seepage into shallow private ground water supplies. Public health officials believe that the use of water from irrigation canals and wells for domestic purposes is

a contributing factor in the high enteric disease rates of several localities in these Basins.

Because of controlled stream flows in these irrigated valleys, there are certain periods of the year during which the quantity of water available is inadequate to provide for dilution and natural purification of the municipal and industrial wastes discharged to the waters. This will necessitate a high degree of waste treatment by the municipalities and industries located in these areas.

In many parts of the plateau and plains area of the Pacific Northwest, the pollution of the watercourses is serious; especially when it is realized that ground water strata are either so deep that the driving of wells is exceedingly costly or such strata are completely inaccessible.

Propagation of Fish

Most watercourses in the Pacific Northwest are used for the propagation of gamefish or commercial fish. Salmon and steelhead trout migrate up the watercourses to spawn, and the young in turn pass down them on their way to the Pacific Ocean. Among the stream obstructions that interfere with migration are natural falls, log jams, dams, and pollution. Pollution obstructions, which occur as zones of oxygen depletion near the mouths of streams, not only degrade the waters downstream but also prevent the use of valuable upstream spawning areas.

Wastes from mining operations located at or near the headwaters of many streams have either killed all fishlife for a number of miles downstream or have reduced the value of these streams for game fish propagation.

State and Federal hatcheries are located throughout the area for maintaining both game and commercial fishery resources.

Wildlife

There is an abundance of wildlife in the Pacific Northwest. It is dependent upon the Basins' water resources either the year around or while in migration through the area. Big game abound in the mountainous sections, while small game, fur animals, and birds are plentiful throughout the area.

One of the principal continental routes of migratory waterfowl is through the Basins area. It is estimated that 36 percent of the total migratory waterfowl population of the North American Continent pass through the area annually.

Recreation

The watercourses of the Pacific Northwest blend harmoniously with the rugged mountain scenery to create an area of exceptional recreational opportunities. The inland salt water bays, the fresh water lakes, the many miles of seashore and river systems are used the year around by thousands of people during their leisure hours. Sports fishing is permitted during most months of the year in Puget Sound, along the Columbia River near the larger population centers, and in the more remote and primitive areas such as the Rouge River in southern Oregon, the Kootenai and Flathead Rivers in northwestern Montana, the Jackson Hole country in western Wyoming and many others of equal note. Hunting seasons are of equal importance to residents of the area and outsiders.

Raw sewage discharged by the larger cities into tidal waters adjacent to swimming beaches is a problem in Washington and in some parts of Oregon. Otherwise excellent beaches adjacent to the larger Washington cities located on Puget Sound are posted with signs warning of the polluted waters. Some city officials appear reluctant to correct these conditions except by changing the location of the waste outlets to tidal waters.

Large numbers of vacationists park their trailers along the streams. Sometimes they stop below communities that are discharging raw sewage to the streams and use the stream water which, to them, appears to be potable.

Navigation

In transporting commodities into and out of the Pacific Northwest, ocean-going vessels make use of the inland waters of Puget Sound, the inlets to several harbors located at the mouths of the rivers along the Washington and Oregon coasts, and the Columbia River upstream to The Dalles, Oreg. Barges, tugs and smaller vessels transport freight on the large rivers considerable distances above their mouths. On the Columbia River extensive barge transportation is carried on as far upstream as Pasco, Wash.

Many improvements have been made in river channels to permit extensive use of the waters for navigation. Harbor facilities have been provided at all locations where boats dock in tidal and fresh waters.

Extensive use is made of the water throughout the area for booming logs, particularly near the sites of saw mills, pulp mills and other wood products plants.

Accidental discharges of oil and other wastes from ships and barges and the bark and other debris from log-booming areas generally have resulted in only a visual degrading of the waters. At times, however, these wastes have been toxic to fish and aquatic life. Furthermore, polluted waters tend to increase the maintenance costs of ships and boats and make log handling a difficult and often hazardous task.

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POLLUTION CONTRIBUTED TO WATER RESOURCES

Major pollution of the basins' watercourses is caused by the discharge of sewage and industrial wastes from 434 municipalities, with a total sewered population of approximately 2.5 million, and by the wastes from 824 industries which discharge such wastes directly to the watercourses. Since the pollution contributed by 400 municipalities and 211 industries is over 16,000,000 population equivalent, it is apparent that the combined pollution discharged from all known sources must be considerably in excess of this. Nineteen percent of the known pollution load is contributed by municipalities and 81 percent by industries.

This, however, is only a part of the picture. It does not indicate the bacterial pollution of the water which results from the discharge of raw and inadequately treated sewage. Also it does not indicate the effects of the toxic trade wastes that are discharged to watercourses by 117 or more industries producing inorganic wastes.

Other important factors contributing to the pollution of the watercourses are silt, from eroding agricultural, range and cut-over forest lands, and the logs, bark and other debris washed into streams during floods. Annually millions of tons of silt are taken out of the Columbia, the Willamette and other rivers to provide the necessary river depts for navigation.

The most severe bacterial pollution occurs in the Willamette River, in the tidal waters near large population centers on Puget Sound, and in the waters of the highly developed irrigated valleys of the Snake River and the Yakima River. Surveys indicate that these waters are highly contaminated. Their use for various purposes presents a potential health hazard.

The inorganic wastes discharged to the streams are principally mine tailings, acids, and toxic chemicals. Probably the greatest stream degredations found in the area are caused by the discharge of tailings from ore concentration mills and acid ore mine wastes. These wastes contain many chemicals which are detrimental to normal water uses and cause depositions which destroy the aquatic life in the streams. More than 100 miles of the basins' watercourses have been degraded in this manner. The principal industries discharging inorganic wastes to the basins' watercourses are ore concentration mills and smelters, an ore precipitation plant, metal plating plants, aluminum plants and coal and gravel washing plants.

Information on sources and amounts of municipal and industrial pollution is presented in Tables A and B.

Table A. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	400[1]	2,391,108[2]	3,002,187[3]
Having population data available (Data on pollution load to watercourse incomplete or not available)	34[4]	74,230[5]	Not applicable
Total	434	2,465,338	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewage systems.

[1]Includes 20 unsewered communities from which septic tank effluents with an estimated P.E. of 29,092 seeps into watercourses.

[2]Does not include population of 20 unsewered municipalities.

[3]Industrial wastes of unknown strength and volume discharged to city sewers by 126 food industries, 3 textile industries and 27 toxic waste producing industries.

[4]No information available regarding strength and volume of wastes discharged to city sewers by 56 food industries and 1 paper products industry.

[5]Sewered population of 7 municipalities and 4 military establishments not available. Does not include the population of 4 unsewered communities from which septic tank effluents of unknown P.E. seep to watercourses.

Table B. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	211	12,825,773
Producing organic wastes	432	Undetermined
Producing inorganic wastes	117	Not applicable
Producing wastes of undetermined type	64	Undetermined
Total	824	--

*Industries having separate outlets and discharging wastes directly to watercourse.

DAMAGES TO WATER RESOURCES FROM POLLUTION

Water is probably the Pacific Northwest's greatest natural resource. Until the establishment of the aluminum industry, local raw materials were sufficient for most of the area's industrial and manufacturing uses. With the availability of excellent harbor facilities and low-cost hydroelectric power this picture is now changing rapidly. Raw materials are being imported to the area for processing and this practice will continue to expand. This, unquestionably, will place a greater demand on the basins' water resources.

Although the organic pollutional load discharged to the watercourses is comparable to the waste discharge from more than 16 million people, the steep gradients, high falls and large flows found in most of these streams tend to effect a rapid stabilization of organic wastes, the full effectiveness of which is not presently known. Even with this great natural recovery potential, however, some of the larger watercourses have become seriously polluted.

The public is aware of the need for a coordinated program to correct and abate pollution and has supported for some time the efforts of the State water pollution control agencies. An excellent example of this public support was the enactment in 1938 of an Oregon water pollution control law which created the State Sanitary Authority and invested it with powers to control water pollution. Similar action in Washington created a single pollution control agency in 1945.

In areas where pollution has or is damaging the waters, abatement programs are well under way. The Willamette River Basin in Oregon is one example of this. Organic wastes discharged to this river are comparable to the wastes from about 4 million people. Eighty-five percent of the wastes are discharged by industries. Principal damages to the river are interference with full development of the fishery, destruction of recreational areas, depreciation of waterfront property values, and serious impairment of present and future water supplies. The present program for pollution abatement in the Willamette River Basin, scheduled for completion by 1952, will require an expenditure of about 30 million dollars by municipalities and industries.

Another example of serious pollution damage is the Puget Sound Basin in Washington. Here large population increases and tremendous industrial growths during the past decade have made the pollution problem serious. Raw sewage discharged into tidal waters, together with wastes from pulp and paper mills, chemical and metal plating plants, and those of a variety of other industries, are creating conditions which are hazardous to health, destructive to extensive fishery, damaging to waterfront property values, and spoiling the recreational opportunities of an area catering to millions of tourists annually. Organic pollutional wastes with a population equivalent of 6 million are discharged to watercourses in this basin, about 86 percent of which is contributed by industries.

In the highly developed irrigated valleys of the Upper and Central Snake River Sub-Basins in Idaho and the Yakima River Sub-Basin in Washington, unusually high rates of enteric diseases in the past several years have occured during the late summer and fall months. Public health officials believe that a contributing factor to these outbreaks is the discharge of raw and inadequately treated domestic sewage into streams from which water is diverted for irrigation. This contaminated water is spread over thousands of acres of land with subsequent seepage into the shallow ground water supplies serving many people living in these rural areas. In addition, many of the people residing in these areas obtain drinking water directly from the irrigation canals or from cisterns filled with water from the canals.

As yet there is not sufficient information to assess fully the damages caused by mining operations. In the headwaters of many streams gold dredges have been allowed to continue unrestricted operations, even though there is notable visual evidence of stream pollution as a result of such operations. In other streams, however, the efforts of sports and conservation groups have been responsible for causing dredging operators to discontinue polluting valuable fishery streams.

Fortunately, the big mining operations-copper, lead, zinc, silver, gold, etc.,-have been concentrated in three relatively confined areas. In some localities these mining companies have worked out their own methods of control which have reduced the amount of wastes entering the watercourses. In other localities, however, such as the Clark Fork River below Butte, Mont., the south fork of Coeur d'Alene River below Mullan, Idaho, and the Pend Oreille River below Metaline Falls, Wash., large mining operations for years have degraded streams by the discharge of wastes directly to the watercourses.

In the Pend Oreille River below Metaline Falls, Wash., production of lead and zinc will be increased considerably by plants now under construction.

Records of damages from mining operations are not complete. There have been many complaints from land owners, fishery people and public health officials in addition to law suits to collect damages. Mine owners along the Clark Fork and Coeur d'Alene Rivers have purchased the abutting lands to avoid further damage suits. They have expended large sums of money in constructing tailing ponds and settling basins and in improving river dredging operations. Even with these excellent efforts toward prevention of pollution, some 100 miles of watercourses have been destroyed for most normal water uses. Additional stretches of streams have been damaged although the extent of such damage is not known.

The above examples are descriptive of the most severe pollution damages to watercourses in the Northwest. There are sections along the shores or Oregon and Washington where local shellfish and bathing areas have been destroyed. In addition, there have been occasional localized fish kills from the discharge of heavy organic loads or toxic trade wastes.

Stream damages from soil erosion are now being investigated by the Soil Conservation Service and Forest Service of the Department of Agriculture. Joint flood control surveys by these two agencies are underway in the Willamette, Snake, Walla Walla, Willow and Palouse River drainage basins. The silt, logs, bark and other debris washed into these and other streams from farm and cut-over forest lands are destroying valuable fish spawning areas, blocking watercourses, decreasing the watershed values for public water supplies, and increasing the treatment costs of water supplies for domestic and industrial uses. In addition, the logs and bark carried downstream during floods destroy recreational areas and property in the lower valleys. Silt deposits in the river beds impede navigation and require extensive dredging to maintain adequate depths.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Benefits resulting from pollution prevention and abatement in the Pacific Northwest have been mostly local in nature. The Yakima River Basin is the only area where a pollution control program has produced benefits on a basin-wide basis.

Even in the Yakima River Basin, where 15 of the 17 sewered communities have constructed treatment plants, subsequent population growths and industrial expansions have increased the waste loadings to treatment plants and the watercourses in amounts sufficient to offset the earlier gains made by many communities. Undoubtedly improvements in health resulted from the elimination of raw sewage from the watercourses and irrigation canals of the Yakima Basin. Enteric disease rates in Yakima County dropped from 89.4 cases to 11.1 cases per 100,000 population after construction of the Yakima and other municipal treatment plants. This rate, however, is again increasing as indicated by the rate in 1945 of 112.3 cases per 100,000 population — the highest of recent record.

The Weyerhaeuser Timber Company's mill on the lower Columbia River at Longview, Wash. has developed and installed a magnesium base sulphite pulping process, which burns all sulphite liquors and recovers both chemicals and heat. This process appears to be applicable particularly to other large capacity sulphite pulp mills. In its operation, returns in the form of chemicals and heat are expected to be sufficient to pay operation costs and may defray the initial capital cost of installation. By use of this process, the 17 sulphite pulp mills located in the Pacific Northwest, and now without adequate treatment facilities, could with an expenditure of about 35 million dollars reduce the total organic pollutional discharge in the basin by at least 50 percent.

In one of the numerous inlets to Puget Sound below the Shelton Rayonier, Inc., the discharge of sulphite pulp mill waste caused the destruction of several important oyster producing areas a number of years ago. Since these areas were producing the famous Olympia oysters, the damage was considerable and the pulp mill was required to pay damages. Later the Company installed the ammonia base process for making pulp and constructed a new plant for burning the waste liquor. As no chemicals or heat are recovered in this operation, the Company realizes no returns on operating the incinerating plant. As a result of burning the waste, it has been possible to restore these valuable oyster growing areas.

The Soundview Pulp Company and Crown Zellerbach are now cooperating in an experiment, at Lebanon, Oreg. to recover heat, from the waste using the ammonia base process. If this experiment proves successful it may solve the waste treatment problems of the smaller pulp mills, since the capital investment for this process is not as great as for the magnesium base process. Conversion of existing calcium base mills to the ammonia base process will probably require the least capital investment and modification in existing facilities.

Sulphite pulp mill wastes which have affected the shellfish industry in Bellingham Bay have been partially eliminated by construction of an alcohol recovery plant by the Puget Sound Pulp and Timber Company at Bellingham. Since installation of the alcohol recovery plant it has been possible to reestablish the oyster producing industry in this area.

The Rayonier, Inc. pulp mill at Hoquiam, Wash., had, for a number of years, been discharging its sulphite wastes into Grays Harbor near the mouth of the Chehalis River. This caused an oxygen depletion zone at the mouth of the river which prevented the salmon from migrating upstream to spawning grounds and the fingerlings from returning to the ocean. The Company constructed a lagoon for impoundment of wastes during low flow periods in the river and has been attempting to maintain at least five parts per million of oxygen in the water at the mouth of the river. This has been of material benefit in preserving the salmon runs in the Chehalis River. Subsequent operation of the lagoon, however, has indicated that additional lagoon storage capacity or other effective treatment methods will be required to maintain the minimum dissolved oxygen content of the water at the river mouth.

In the Central Snake River Sub-Basin the two largest municipalities, Boise and Nampa, Idaho, have recently completed the construction of secondary municipal waste treatment plants. In the past, the raw sewage from these cities had been diverted along with most of the water in the river for irrigation. Undoubtedly greater protection to the health and welfare of the people living in this basin will result from the construction and operation of these treatment plants.

A 1,000-ton per day capacity coal washing plant located in the Central Snake River Sub-Basin is known to have installed a hydraulic classifier for collecting coal dust and fines. By this recovery process a badly polluted creek has been cleaned up and the fish kills

which were occurring have ceased. It cost this company about $50,000 to install equipment and settling basins. From 15 to 20 tons of coal fines are collected daily from wastes which previously were being discharged to the creek. In the treatment process, water is recirculated and thus a savings is also realized in reduced pumping costs. The total annual savings to this plant is estimated to be $30,000. Should the other 12 coal washing plants located in the Pacific Northwest employ such recovery and pollution prevention measures, they also might realize a saving and pollution of the basins' watercourse would be greatly reduced.
From 15 to 20 tons of coal fines are collected daily from wastes which previously were being discharged to the creek. In the treatment process, water is recirculated, and thus a savings is also realized in reduced pumping costs. The total annual savings to this plant is estimated to be $30,000. Should the other 12 coal washing plants located in the Pacific Northwest employ such recovery and pollution prevention measures, they also might realize a saving and pollution of the basins' watercourses would be greatly reduced.

Through good housekeeping and use of recovery measures, milk products and meat packing plants can substantially reduce the cost of municipal treatment facilities where such wastes are discharged to city sewers or can eliminate a major portion of their wastes where such are discharged directly to watercourses. By good housekeeping practices a milk plant can reduce its normal losses by about two percent of the plant intake. This represents about 70 percent of the total wastes produced by a milk plant operated without good housekeeping methods.

At meat packing plants and slaughterhouses the recovery of blood will pay for the cost of collection facilities under ordinary market conditions. Ordinarily blood collection is required of plants discharging waste to municipal sewers; however, a majority of the plants located in the Pacific Northwest are discharging wastes directly to watercourses. Some of these now collect blood, grease, paunch manure and other waste products—others do not. If market conditions are favorable, a plant processing 20 animal units daily might pay for the installation of about $11,000 worth of recovery facilities through sale of blood collected from its wastes. The larger plants, by installing blood drying and rendering equipment, might realize a profit on the investment. Utilization of recovery facilities by the more than 170 meat packing plants located in the area would materially reduce pollution of the watercourses.

Ore concentration mills, are dumping annually more than a million tons of mine tailings into watercourses. Acid mine wastes are disposed of in the same manner. For the present, pending development of practical disposal methods, it may be necessary to continue to use stretches of certain streams for receiving these wastes. Mine owners should be required to develop and provide the necessary treatment of their wastes. When this can be done many miles of the basins' watercourses will be reclaimed and normal water uses again restored.

The soil erosion and flood control programs of the Department of Agriculture are of tremendous value in reducing the silt load of the basins' watercourses.

Analysis of State Water Pollution Control Legislation

The control of water pollution has been of primary concern to State officials and people residing in the Pacific Northwest for several years. The first attempts to prevent the destruction of the water resources were made through regulatory powers invested in various State agencies. In most of the States adequate powers have been given to the Health Departments for the protection of Public Water supplies and other water uses where the health of the people might be endangered from pollution. Agencies responsible for the conservation of water for other uses, however, have not always been given adequate water pollution control powers.

Much credit must be given to State Water pollution control agencies and other State agencies interested in the conservation of water resources and for the construction of treatment facilities and waste prevention measures which have resulted from their administration of existing laws.

The following analysis presents briefly the salient features of water pollution control legislation of the various States in the Pacific Northwest Drainage Basins. It is based on previous analyses of State legislation which were reviewed by the various States and used in the development of a Suggested State Water Pollution Control Act which was subsequently endorsed by the Council of State Governments and recommended to the States for favorable consideration.

Two of the States in the Pacific Northwest Drainage Basins--Oregon and Washington--have established special State-wide authorities which have general water pollution abatement, prevention and control powers and duties. Oregon has established a Sanitary Authority which is composed of three ex-officio members representing State departments, and three members appointed by the Governor. The Pollution Control Commission of the State of Washington is composed of five ex-officio members representing State government and a director appointed by the Governor. The director of this Commission has no voting power.

In all seven States the State Health Departments have water pollution control functions as they relate to public health aspects of the problem.

Oregon and Washington are the only States in the Basins which provide, by statute, for an executive officer to be in charge of the water pollution control program. Similarly, these are the only States in the Basins which are required, by statute, to develop a comprehensive program for the prevention, abatement and control of water pollution. The Oregon State Sanitary Authority and the Washington Pollution Control Commission have the powers to set standards on water quality.

By statute, Montana, Oregon, Washington and Wyoming require the approval of plans and specifications for the construction of new sewerage systems and treatment works, modifications and extensions thereof. Oregon and Washington require approval of plans for industrial waste disposal facilities. Statutes of the State of Montana require the issuance of permits to construct waste disposal facilities. Nevada requires permits only for discharge into Lake Tahoe or its tributaries. Idaho, Oregon, Utah and Washington do not have any statutory requirements for permits.

All the States in the Basin except Idaho are authorized to issue rules and regulations relating to water pollution control.

In Oregon and Washington, the water pollution control authorities are specifically authorized by statute to issue orders to abate pollution. Hearings are required prior to the issuance of such orders in Oregon. In Washington offenders may petition for hearings after issuance of orders.

The Montana and Wyoming health authorities are authorized, by statute, to issue orders relating to water pollution control which affects aspects of public health; hearings are not required by statute prior to the issuance of such orders. The Nevada and Utah statutes do not provide for the issuance of administrative orders in the field of water pollution control.

Of the States which are authorized to issue orders, Montana, Oregon, Washington and Wyoming have specific statutory authority to hold administrative hearings; Oregon is authorized to issue subpoenas and Montana and Wyoming are authorized to issue subpoenas and administer oaths in connection with such orders.

The only State in the Basins which provides exemptions from water pollution control statutes is Idaho, which exempts quartz mills if a settling dam approved by the State Fish and Game Commission is constructed in connection therewith.

Although the water pollution control laws in some of the States of the Pacific Northwest are inadequate, much has been done to prevent pollution of the watercourses. In addition to

the work of the State agencies, conservation and sports groups, people dependent upon the tourist industry for a livelihood, and many others affected by pollution, including industries, have been helpful in getting waste treatment facilities constructed.

The pollution control programs adopted by the States have not been of recent development. State pollution control agencies have been assembling data for a number of years and have had their programs underway for some time.

Sewage treatment plants have been installed by 229 municipalities having a total sewered population of over 600,000 people. Although these provide treatment for 56 percent of the sewered municipalities in the Pacific Northwest, only 25 percent of the total sewered population is so provided.

There are 148 industries known to have waste prevention measures or treatment facilities. This represents 18 percent of the total number of industries known to be discharging wastes directly to public waters. It must be pointed out that this figure may change upward since the existence of facilities for waste prevention or treatment that may be employed by 481 industries has not been determined. Data relating to existing municipal and industrial treatment facilities and their adequacy are presented in Tables C, D and E.

The fact that treatment facilities or waste prevention measures have been installed does not necessarily mean that the municipalities and industries so provided are adequately treating the wastes discharged to the watercourse. In the case of municipal waste treatment plants, unexpected population increases and increasing quantities of industrial wastes discharged to the sewer system have overloaded many existing facilities. In addition, oftimes insufficient attention is given to plant operation. Industries, likewise, may be lax in their operation of treatment facilities, but more often it is found that the existing facilities provide for only partial treatment or the recovery of only a small portion of the total wastes produced.

Of the 228 existing municipal waste treatment plants, 121 are adequate in capacity and 139 are operated satisfactorily. Eighty-six are inadequate in capacity and 68 are operated poorly. The adequacy of capacity and operation of 21 plants has not been determined.

Only 11 of the 148 industrial waste treatment facilities are known to be of adequate capacity and only 12 are known to be operated satisfactorily. Five are known to be inadequate in both capacity and operation. No determinations have been made on the adequacy of capacity at 132 or the adequacy of operation at 131 of the industrial waste treatment facilities. Some of these industries are known to provide only such measures as screens, blood and paunch manure collection and recovery of beet pulp. These measures generally are not considered adequate treatment for such industrial wastes, and have been included in the undetermined group until more complete information is available.

Thirty-nine of the 228 municipal waste treatment plants have been constructed since the War. These new plants were designed to serve a population of 234,520. During this same period 2 industries, discharging wastes with a population equivalent of 1,030,000, are known to have installed treatment facilities. Undoubtedly many others have installed screens and other waste prevention measures, although information regarding them is not available at this time.

Table F shows the municipal and industrial plants constructed since the War. It is interesting to note the number and size of the waste treatment plants completed in 1949. Construction of some of these was started prior to 1949 but was not completed until that year. The number of municipalities with plans in varying stages of completion indicates that this trend will continue if materials remain available and costs do not materially increase. Industrial treatment facilities completed since the war include a high capacity trickling filter to treat cannery wastes and one magnesium-base sulphite pulping process. Not included in the list of plants constructed since the War is the 17 million dollar Portland municipal waste treatment plant. This plant is scheduled for completion during 1951.

There has been organized a Pollution Control Council of the Pacific Northwest, which consists of representatives of the various

Table C.

Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities[1]	Plants	
Primary	141	142	325,212[2]
Secondary	88	86	282,411[3]
No treatment	182[4]	0	1,857,715[3]

[1]Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers; sanitary sewage wastes discharged by industry directly to watercourse.

[2]Sewered population of 3 municipalities not available.

[3]Sewered population of 4 municipalities not available.

[4]Includes 1 municipality for which no determination has been made as to the existence of treatment facilities. One large municipality (Seattle) included under both "Primary" and "No Treatment" categories.

953188 O - 51 - 3

State pollution control agencies in the Pacific Northwest, including those of the Dominion of Canada and Territory of Alaska. This Council through its various committees is developing uniform standards for the disposal of domestic sewage and industrial wastes and water quality objectives. The Council is consulting with State universities and others engaged in research activities for the purpose of eliminating duplication of activities. It also sponsors industrial waste conferences. Another important activity of this group is the promoting of joint surveys on interstate and international waters to determine the pollution problems involved and foster corrective action. Joint surveys have been made on the Columbia and Pend Oreille Rivers above and below the international boundary, and similar surveys are now underway on the Snake River with Idaho, Oregon, and Washington participating.

Prevention of soil erosion through measures designed to conserve water and retard run-off from agricultural lands has been the primary objective of the program of the Soil Conservation Service of the Department of Agriculture. This agency is responsible for the excellent progress in this field. One hundred thirty-nine local Soil Conservation districts, embracing a total of over 75 million acres of agricultural lands, have been organized. In these districts, programs of soil and water conservation applicable to individual farms are being carried out by the farm operators concerned, with technical and material assistance from the Conservation.

Table D. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Mining-bituminous and other soft coal	13	2	0	11
Nonmetallic mining and quarrying	10	3	0	7
Other mining industries	54	14	29	11
Food and kindred products	570	81	116	373
Textile mill products	17	10	4	3
Lumber and wood products	50	3	15	32
Furniture and fixtures	1	0	0	1
Paper and allied products	34	10	15	9
Chemicals and allied products	13	2	4	7
Products of petroleum and coal	11	6	1	4
Stone, clay and glass products	7	3	0	4
Rolling, steel	1	0	1	0
Rolling, nonferrous metals	1	1	0	0
Primary metal industries	8	2	2	4
Fabricated structural metal products	7	1	2	4
Metal plating	3	0	0	3
Machinery	1	0	1	0
Motor vehicles	1	1	0	0
Aircraft	2	0	2	0
Ship and boat bldg.	3	1	2	0
Misc. manufacturing	12	4	1	7
Atomic energy	1	0	0	1
Railroad servicing	4	4	0	0
Total	824	148	195	481

*Industries with separate outlets and discharging directly to watercourse

Table E. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	228	121	86	21	139	68	21
Industrial	148	11	5	132*	12	5	131

*Includes 35 industrial waste treatment plants which are known to be providing adequate treatment for present conditions and 8 industrial waste treatment plants which are known to require additional treatment measures although the adequacy as to capacity is undetermined. This information is reflected in the tabulation of needs under table G.

Table F. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	2	250	Unknown	--
1947	6	18,000	Unknown	--
1948	9	35,870	1[1]	30,000
1949	22	180,400	1[1]	1,000,000

[1]Information regarding construction of other industrial waste treatment facilities not available.

during critical periods of low stream flow. At the present time this one plant does not plan to reduce the quantity of its wastes but will provide a diffused outlet into the Columbia River which will eliminate a local pollution condition.

Table G. Requirements for municipal and industrial waste treatment plants*

Requirements**	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	231[1]	1,904,586[2]	54
Enlargement or additions to existing plant	43[3]	189,086	7
Replace existing plant	57[4]	76,408	6
No project required	128[5]	403,519[6]	58
Undetermined	24	37,845	699

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

**For a listing of individual project needs refer to table I included at the end of each sub-basin discussion following the main part of this report.

[1]Includes 71 unsewered municipalities with a total population of 145,981 requiring both sewer systems and treatment plants. One large municipality included in both "New Plant" and "No Project Required" categories.

Includes 1 plant to serve 2 municipalities requiring treatment facilities.

[2]Sewered population of 2 municipalities not available.

[3]Includes 3 plants classified as satisfactory and 9 as undetermined in capacity but which are known to require a higher degree of treatment.

[4]Includes 1 plant to replace 3 existing septic tanks. Also includes 3 treatment plants classified under capacity satisfactory but which require a higher degree of treatment.

[5]Includes 2 unsewered municipalities with a total population of 125. Also includes 1 municipality having no treatment and 3 classified as to unsatisfactory in capacity but which are small and are considered to require no project at this time.

[6]Sewered population of 3 municipalities not available.

On the basis of an 85 percent reduction in the pollution load of the other eight plants, the total known organic industrial wastes discharged to watercourses of the Pacific Northwest will be reduced by about 42 percent upon completion of the necessary construction work for these plants. This, of course, will not represent the total reduction in pollution by industries. There are 58 other industries included in the present program, and many other industries now discharging wastes directly to the watercourses will provide waste prevention and recovery measures as soon as minimum waste treatment requirements have been adopted by the State pollution control agencies.

Industries connected to municipal sewers have not been excluded from the State programs. If surveys show that adequate treatment can be provided by the municipal plant, installation of waste prevention facilities by the industry will be the maximum requirement. Treatment of wastes by the industry will be necessary if it is found that seasonal or peak period wastes of the industry overload the municipal plant.

It is estimated that the present municipal and industrial waste control programs will cost $123,059,000 - $93,294,000 for the municipal projects and $29,765,000 for the industrial waste treatment plants.

Recognizing that these expenditures will take place over a number of years, the estimated costs will be increased due to added factors. These include additional annual obsolescence and rehabilitation requirements, needs of communities installing new sewer systems, normal population increases and industrial expansion, as well as allowance for presently undetermined needs.

One hundred and forty-eight, or about 45 percent, of the projects included in the present municipal program are either under construction or in the planning stage. Twenty-two are under construction, final plans have been approved by the pollution control agencies for 26, and plans are now being prepared for 91. Nine municipal projects are awaiting additional financing before the start of construction. No formal action has been taken toward construction of necessary treatment facilities by 166 municipalities and the status of 41 projects has not been determined.

At the present time the greatest impediment of the construction of municipal sewage treatment works is the difficulty encountered in financing. Prior to the November 1950 election, municipalities in Idaho could not use revenue bonds for construction of sewerage facilities. In the other States where revenue bonds can be used municipalities have encountered difficulties in selling their bonds.

Table H. Status of treatment works project to abate pollution, July 1, 1950

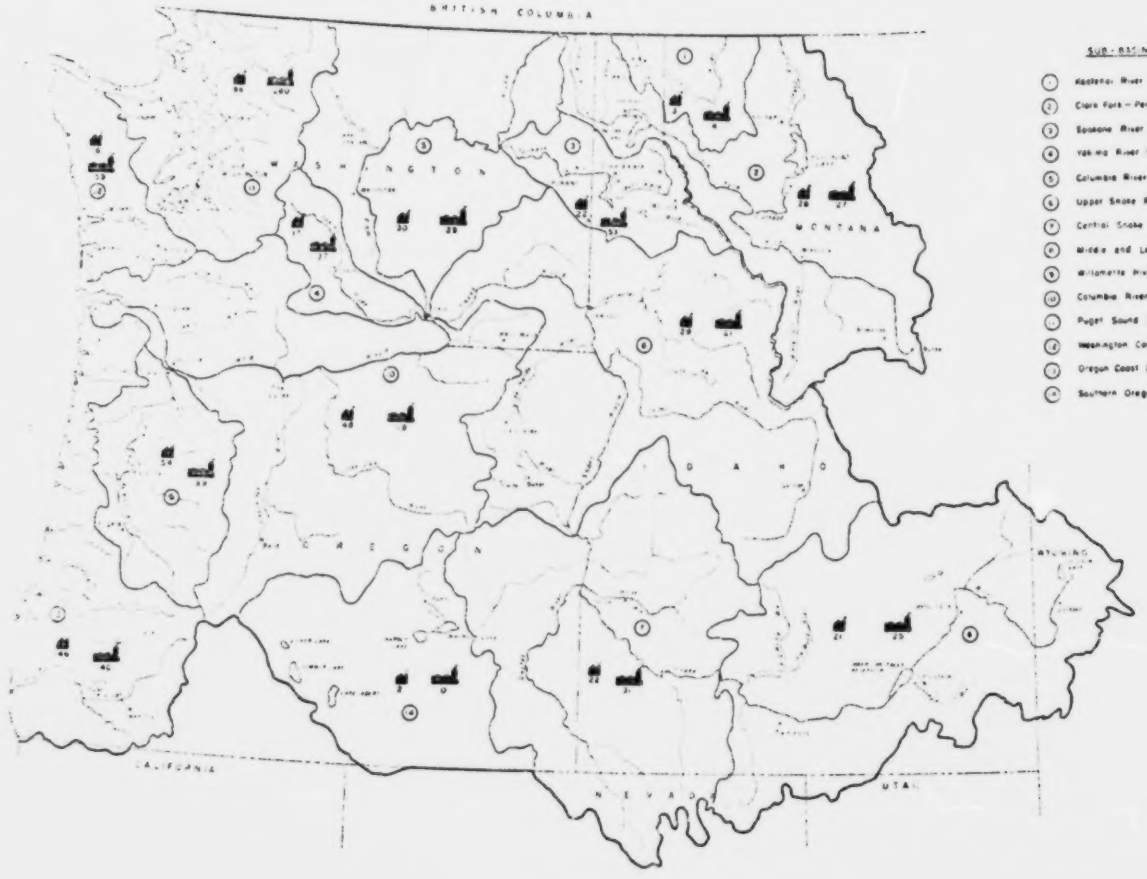
Status of project	Number	
	Municipal	Industrial
No formal action	166	9
Abatement ordered	--	19
Plans under preparation	91	--
Final plans approved	26	--
Construction awaiting financing	9	--
Under construction	22	--
Status undetermined[1]	41	738

[1]Includes 24 municipalities and 699 industries appearing in table G for which treatment needs are undetermined.

The State of Oregon has set up a revolving fund for loans to municipalities of less than 2,500 population for the construction of sewage treatment facilities. This has been helpful to the smaller communities in that State but has not completely solved the problem. It is the opinion of State pollution control agencies in the Pacific Northwest that any Federal grants to municipalities should be confined to financing the preparation of preliminary engineering reports, and that limitations on the amounts of these grants should be liberal. They also are of the opinion that Federal loans, at acceptable rates of interest, for financing the preparation of final plans and construction of treatment works would greatly expedite their programs, and that limitations on the amounts of these loans should be liberal. The State pollution control agencies, in the interest of completing their programs as rapidly as possible, would be in an excellent position to assure that any funds provided would be used most effectively in a comprehensive water pollution control program.

The Oregon State Sanitary Authority and the Washington Pollution Control Commission have ordered 19 industries to abate pollution. The industries--9 sulphite pulp mills and 10 meat packing and rendering plants--are now studying ways to abate their pollution and in some cases plans are well along. The meat packing and rendering plants located on the Columbia Slough, adjacent to the City of Portland, have been given the alternative of either pumping their wastes into the city sewer system or providing adequate waste treatment. Portland's sewage treatment plant will be completed during 1951, at which time these orders will be enforced.

No formal action to abate pollution has been taken by 9 of the 67 industries included in the present industrial program. However, some of these are known to be studying their waste problems in order to obtain economical methods of treatment. The status of treatment works projects to abate pollution is presented in Table H.



SUB-BASIN INDEX

1. Kootenai River Basin
2. Clark Fork–Pend Oreille River Basin
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5. Columbia River Basin above Yakima River
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7. Central Snake River Basin
8. Middle and Lower Snake River Basin
9. Willamette River Basin
10. Columbia River Basin below Yakima River
11. Puget Sound Basin
12. Washington Coast Basin
13. Oregon Coast Basin
14. Southern Oregon Lakes Basin

SCALE OF MILES

0 50 100

NUMBER OF MUNICIPAL SOURCES WITHIN SUB-BASIN

NUMBER OF INDUSTRIAL SOURCES WITHIN SUB-BASIN

See U.S. Follow-up Map for details of SIC.

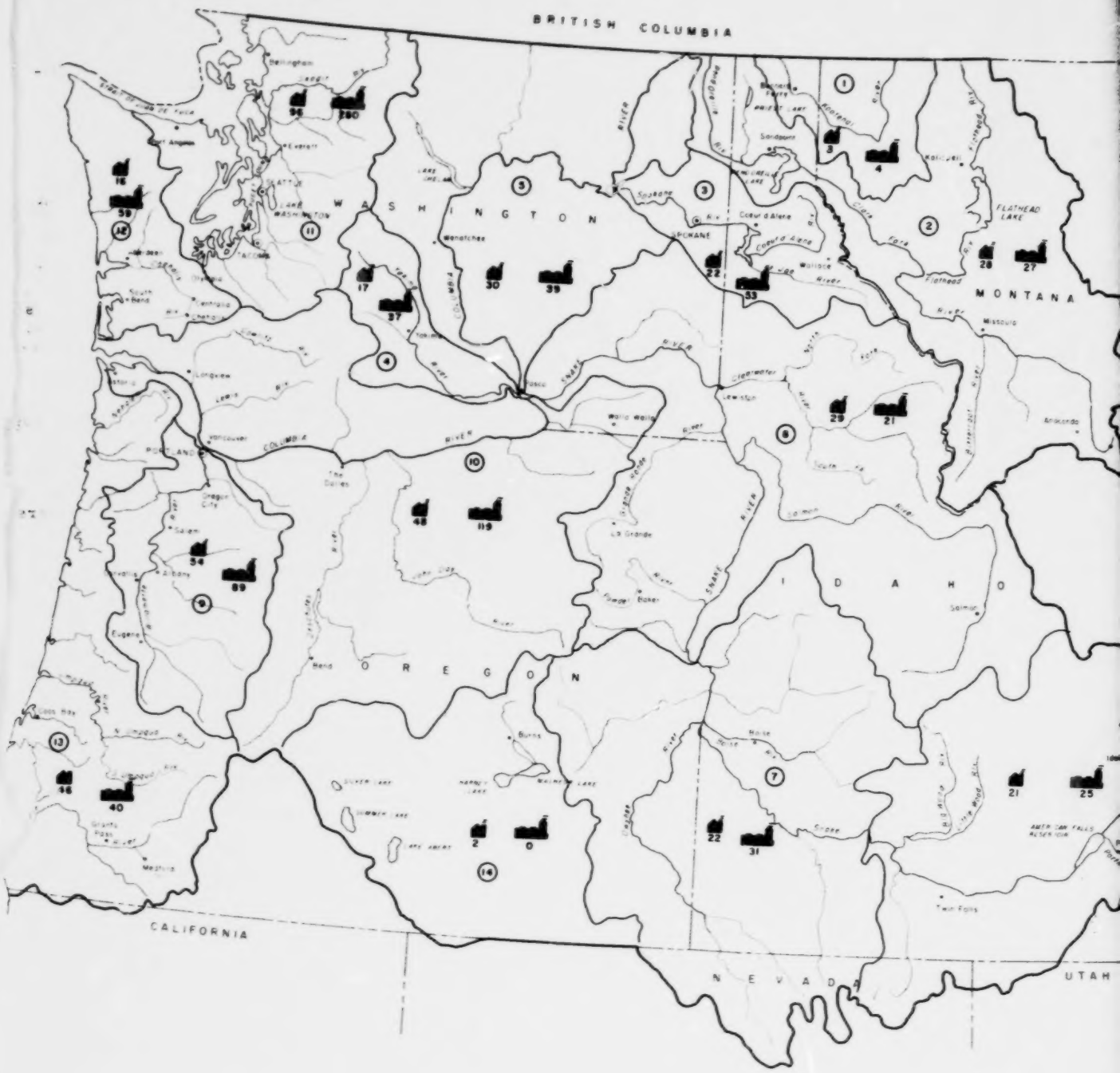
PACIFIC NORTHWEST DRAINAGE BASINS

SOURCES OF POLLUTION

FEDERAL SECURITY AGENCY
Public Health Service
Division of Water Pollution Control
Map No. 1

915165 O - 5. (Face p. 1a) No. 5

19-a



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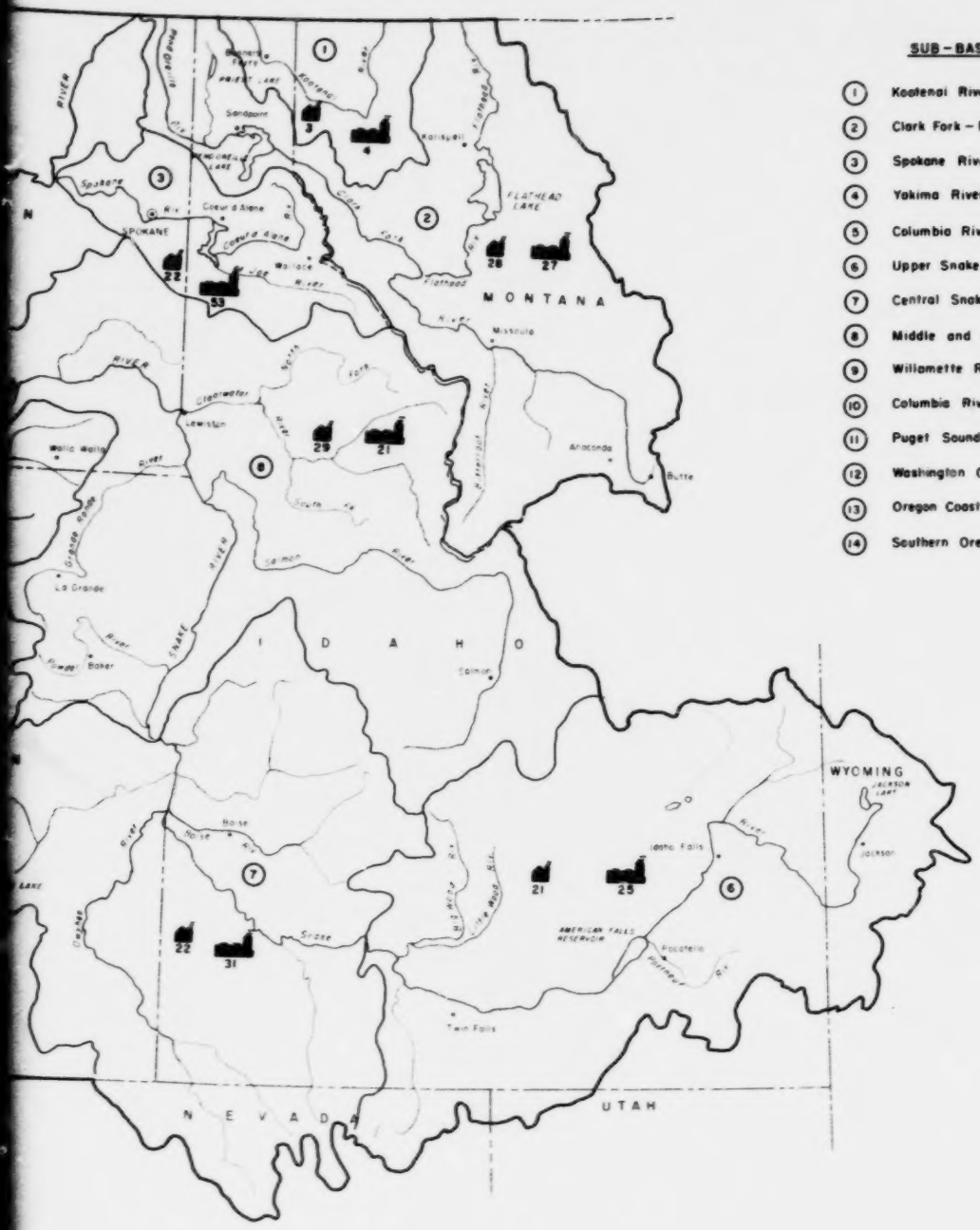
A

19-a

ISH COLUMBIA



SUB-BASIN INDEX

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8. Middle and Lower Snake River Basin
9. Willamette River Basin
10. Columbia River Basin below Yakima River
11. Puget Sound Basin
12. Washington Coast Basin
13. Oregon Coast Basin
14. Southern Oregon Lakes Basin

NUMBER OF MUNICIPAL SOURCES WITHIN SUB-BASIN

NUMBER OF INDUSTRIAL SOURCES WITHIN SUB-BASIN

19-a

PACIFIC NORTHWEST DRAINAGE BASINS

SOURCES OF POLLUTION

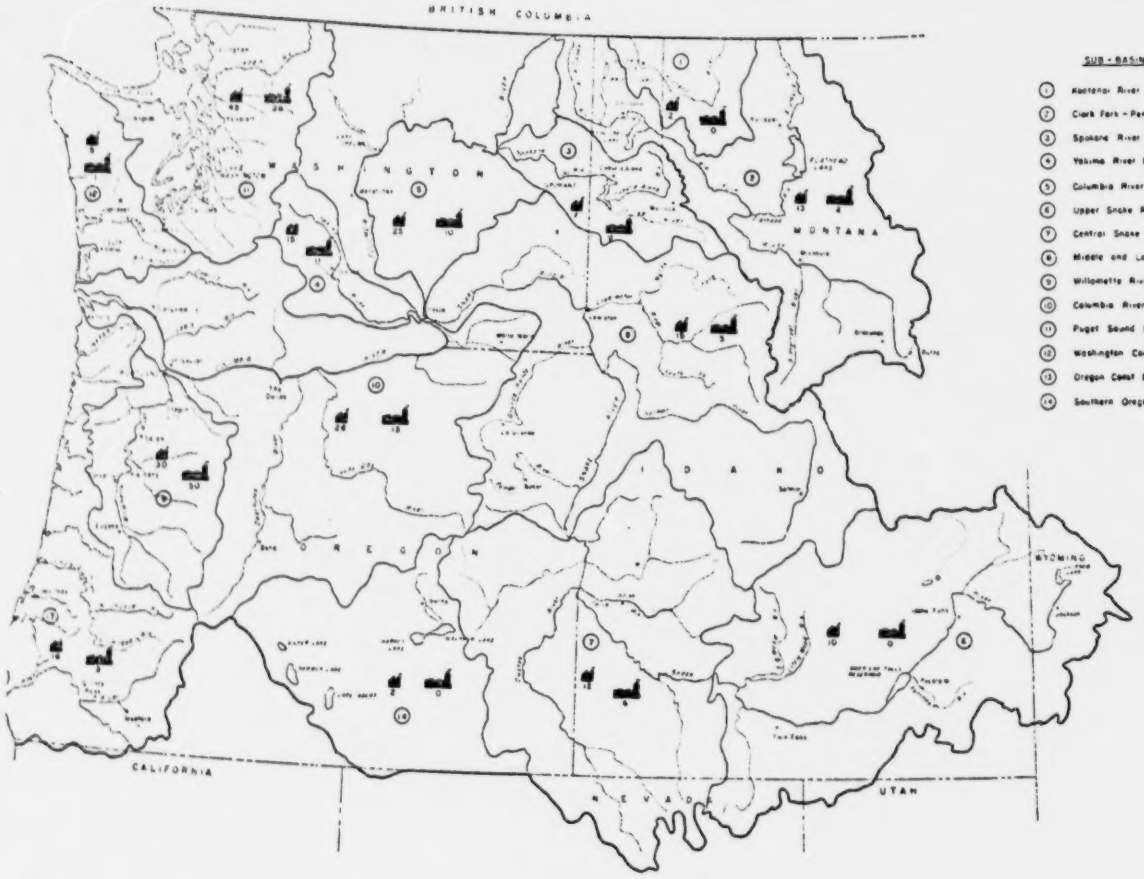
FEDERAL SECURITY AGENCY

Public Health Service

DIVISION OF WATER POLLUTION CONTROL

MAP No. 1

B



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10. Columbia River Basin below Yakima River
11. Puget Sound Basin
12. Washington Coast Basin
13. Oregon Coast Basin
14. Southern Oregon Lakes Basin

XXXXXXXXXXXXXXXXXXXX
See the following page
for explanation of data.
XXXXXXXXXXXXXXXXXXXX

SCALE OF MILES
25 0 50 100

NUMBER OF EXISTING MUNICIPAL TREATMENT WORKS WITHIN SUB-BASIN

NUMBER OF EXISTING INDUSTRIAL TREATMENT WORKS WITHIN SUB-BASIN

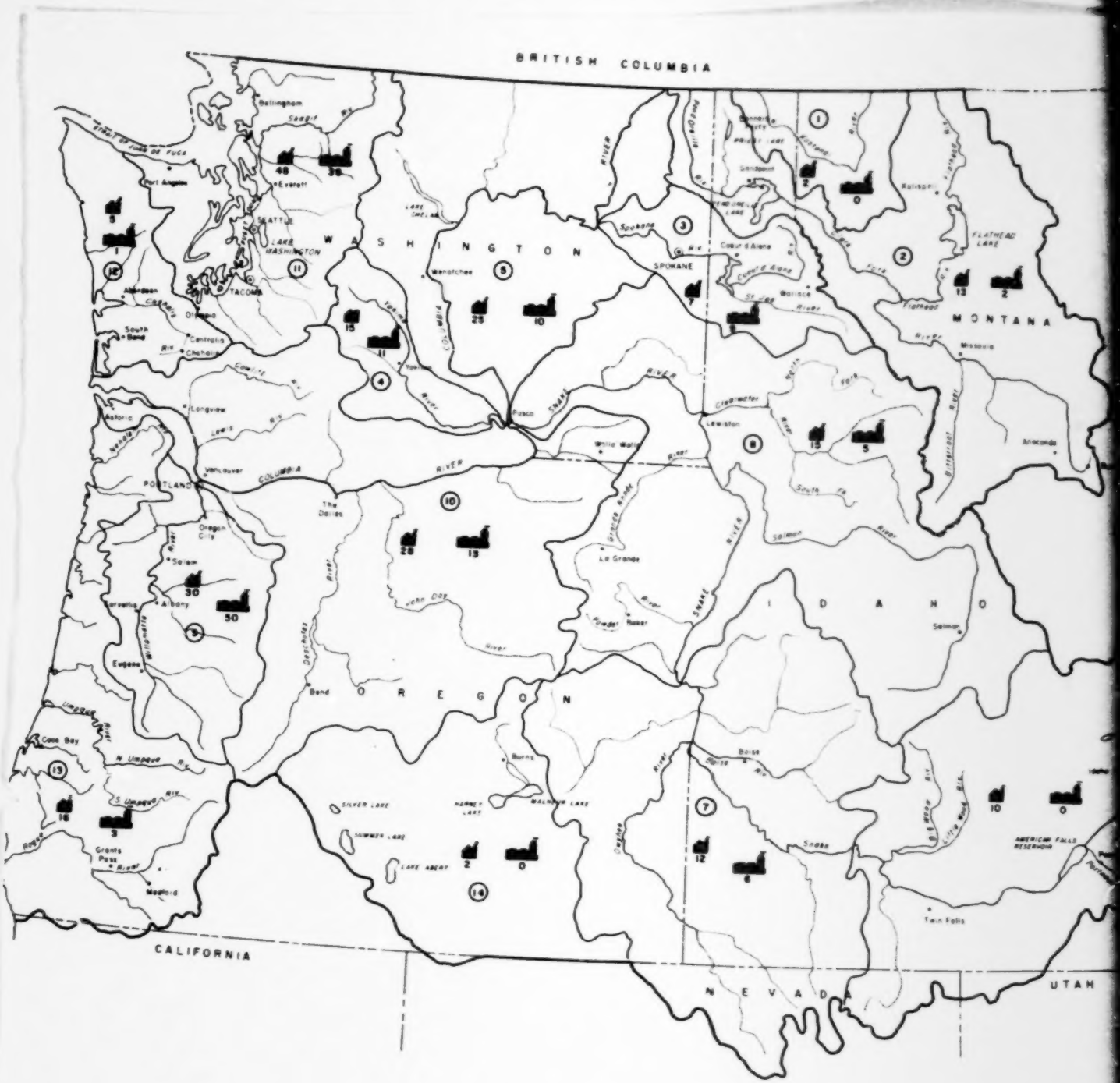
PACIFIC NORTHWEST DRAINAGE BASINS

EXISTING TREATMENT WORKS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 2

953188 O - 51 (Face p. 18) No. 2

19-b



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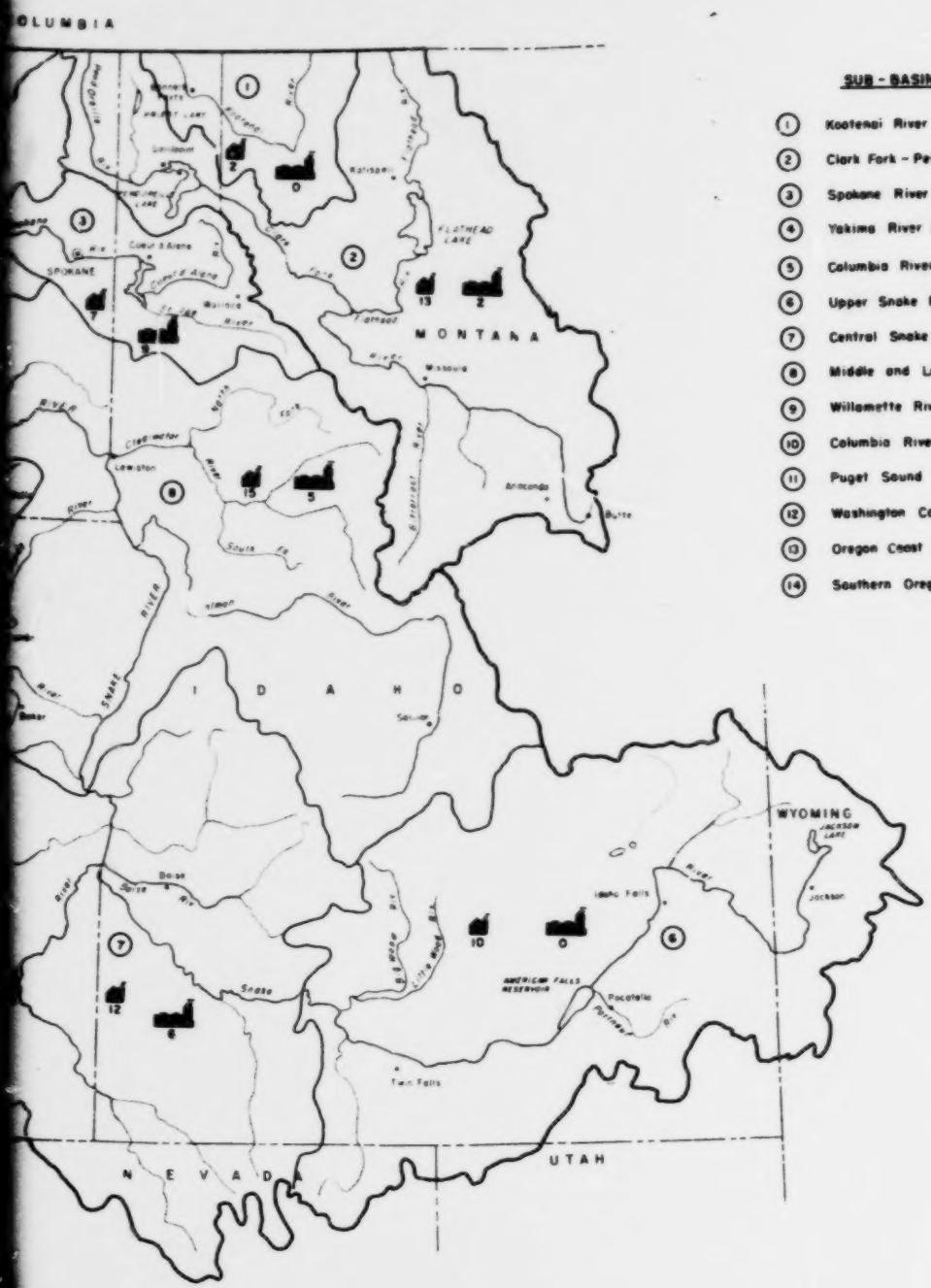
19-t



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NUMBER OF EXISTING MUNICIPAL TREATMENT WORKS WITHIN SUB-BASIN

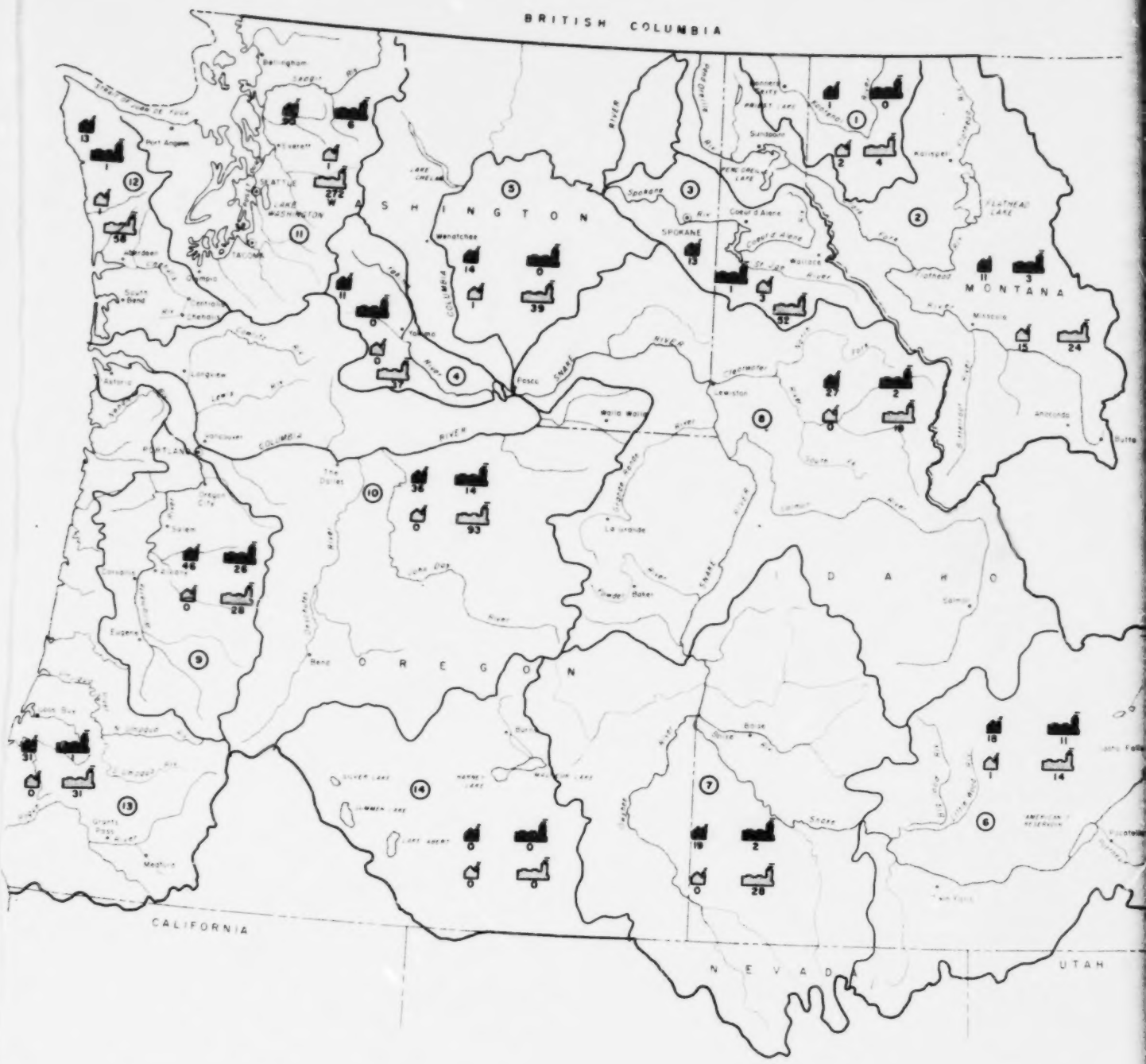
NUMBER OF EXISTING INDUSTRIAL TREATMENT WORKS WITHIN SUB-BASIN

19-b

PACIFIC NORTHWEST DRAINAGE BASINS

EXISTING TREATMENT WORKS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 2

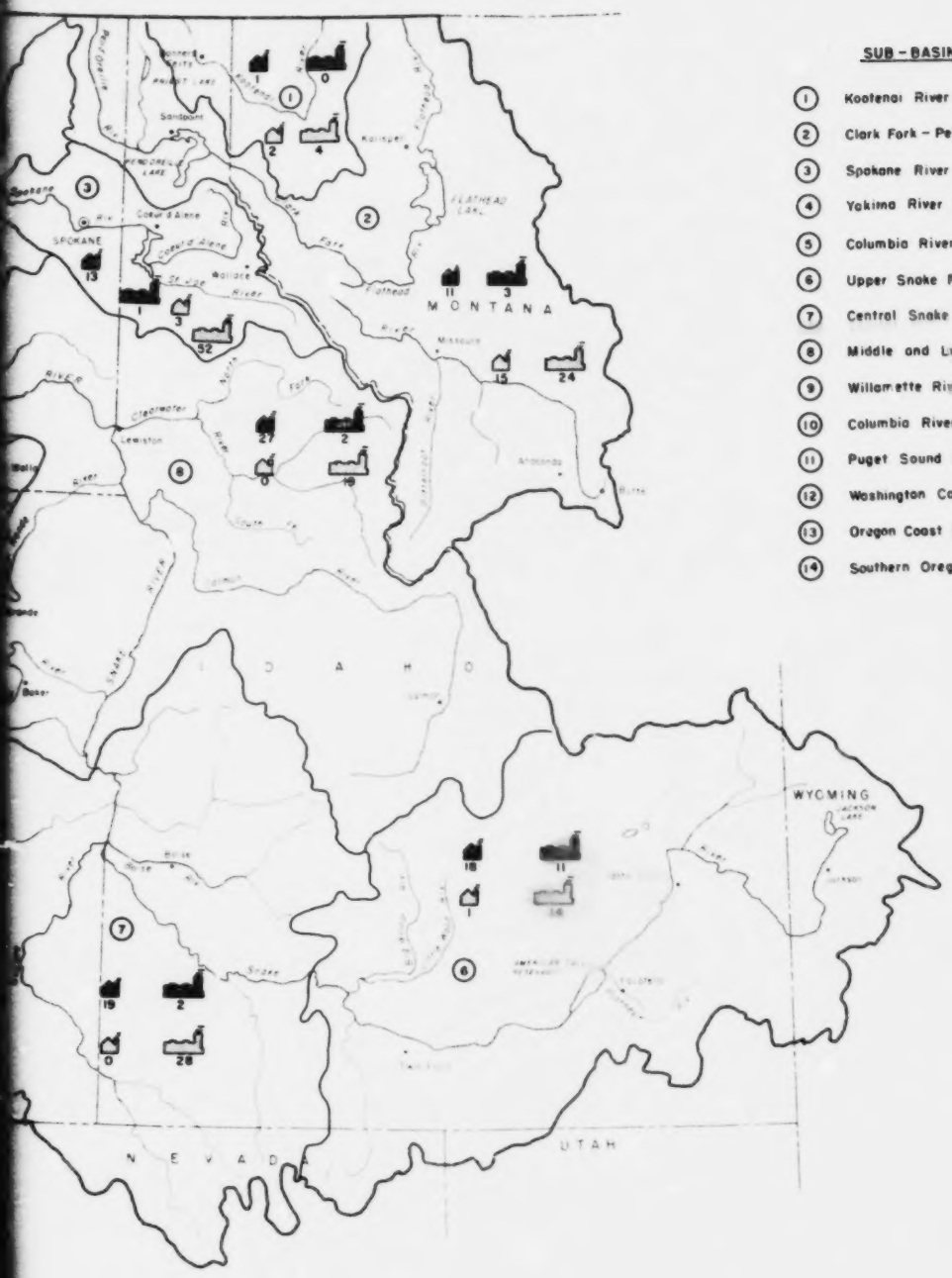

BRITISH COLUMBIA
S H I N G T O N
M O N T A N A
O R E G O N
I D A H O
CALIFORNIA
N E V A D
UTAH
SCALE OF MILES
25 0 50 100
NUMBER OF MUNICIPAL PROJECTS REQUIRED
NUMBER OF MUNICIPALITIES WITH PROJECT REQUIREMENTS UNDETE
NUMBER OF INDUSTRIAL PROJECTS REQUIRED
NUMBER OF INDUSTRIES WITH PROJECT REQUIREMENTS UNDETERM

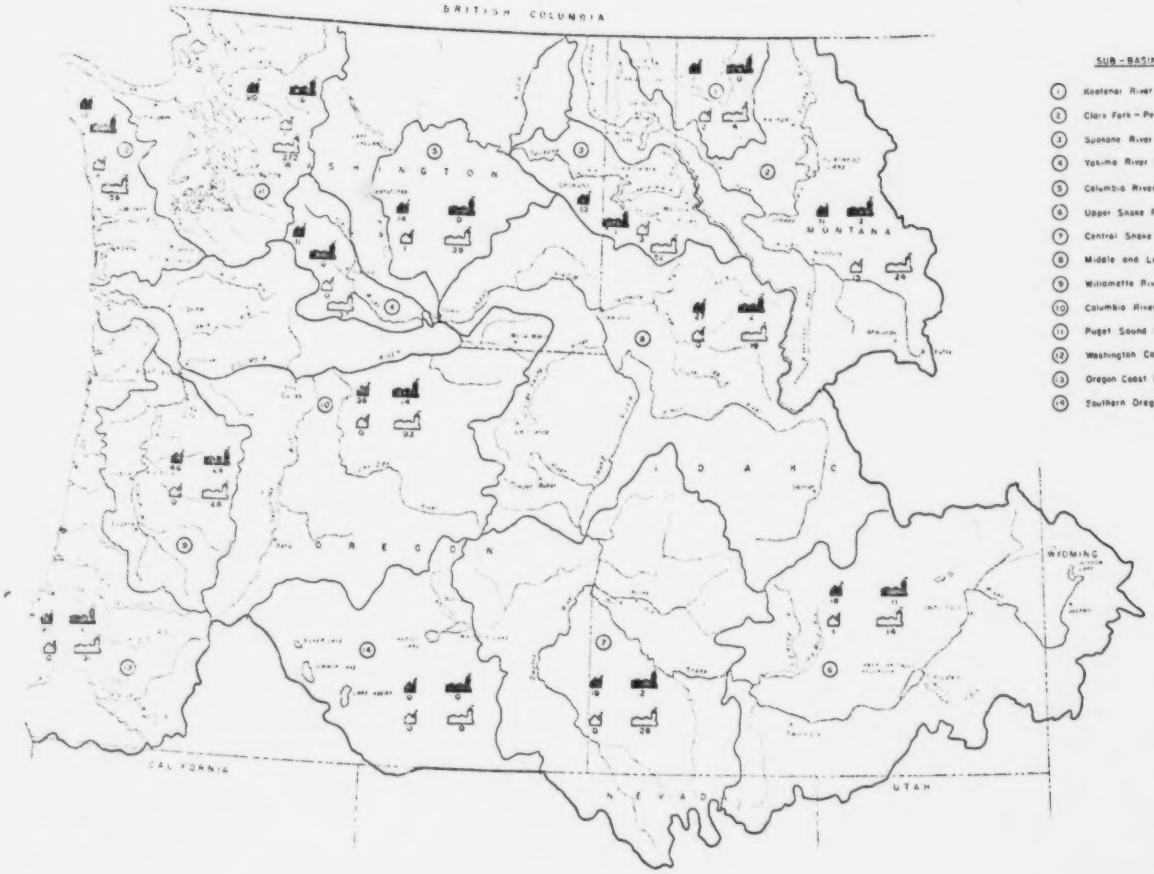
953188 O - 51 (Face p. 18) No. 3

A

19-C

COLUMBIA


MONTANA
IDAHO
WYOMING
NEVADA
UTAH
SPOKANE
Lewiston
Coeur d'Alene
Sandpoint
Kalispell
Missoula
Butte
Helena
Great Falls
Billings
Pocatello
Boise
Twin Falls
Ogden
Salt Lake City
Reno
Las Vegas
Yellowstone Lake
Jackson Lake
Flathead Lake
Pend Oreille Lake
Priest Lake
Columbia River
Snake River
Clearwater River
Salmon River
Bear River
Green River
Wallace
St. Maries
Arimo
Malad
Burley
Rupert
Preston
Logan
Provo
Price
Vernal
Rock Springs
Evanston
Cody
Thermopolis
Riverton
Lander
Rawlins
Laramie
Cheyenne
Casper
Sheridan
Gillette
Miles City
Glendive
Wolf Point
Havre
Shelby
Cut Bank
Kalispell
Whitefish
Libby
Bonners Ferry
Kellogg
Wallace
Moscow
Pullman
Colfax
Walla Walla
Yakima
Ellensburg
Wenatchee
Moses Lake
Ephrata
Grand Coulee
Chelan
Okanogan
Omak
Republic
Colville
Newport
Metaline Falls
Priest River
Sandpoint
Coeur d'Alene
Spokane
Pullman
Lewiston
Clarkston



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12. Washington Coast Basin
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14. Southern Oregon Lakes Basin

XXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
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SCALE OF MILES
25 0 50 100

NUMBER OF MUNICIPAL PROJECTS REQUIRED

NUMBER OF MUNICIPALITIES WITH PROJECT REQUIREMENTS UNDETERMINED

NUMBER OF INDUSTRIAL PROJECTS REQUIRED

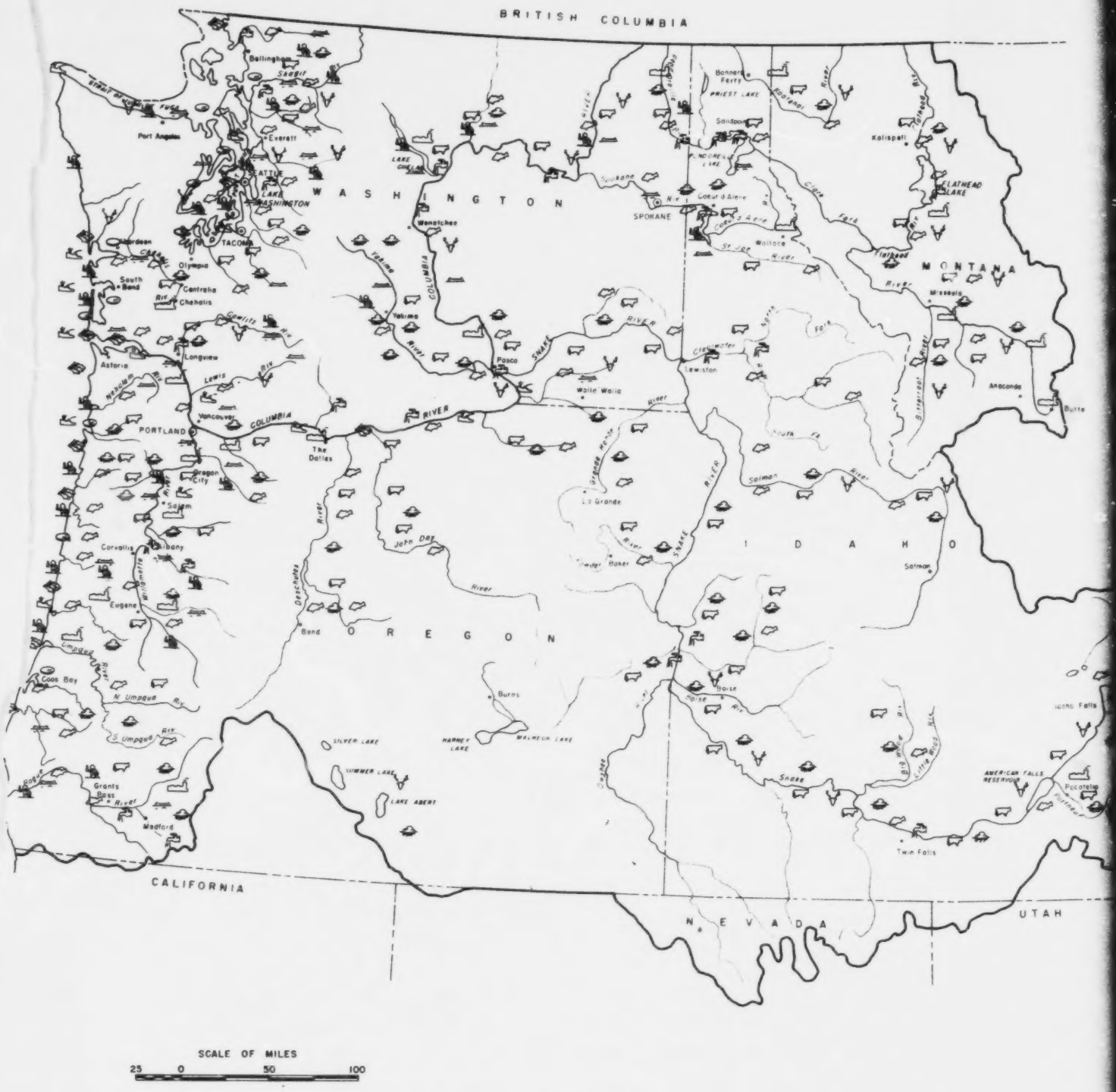
NUMBER OF INDUSTRIES WITH PROJECT REQUIREMENTS UNDETERMINED

19-C

PACIFIC NORTHWEST DRAINAGE BASINS
PROJECTS REQUIRED

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 3

953188 O - 51 (Face p. 18) No. 3



953188 O - 51 (Face p. 18) No. 4

19-d

COLUMBIA

- DOMESTIC WATER SUPPLY
- INDUSTRIAL WATER SUPPLY
- LIVESTOCK
- IRRIGATION
- COMMERCIAL FISHING
- GAME FISHING
- SHELLFISH
- WILDLIFE
- BATHING
- OTHER RECREATION
- NAVIGATION

PACIFIC NORTHWEST DRAINAGE BASINS

EXISTING PRIMARY WATER USES

FEDERAL SECURITY AGENCY

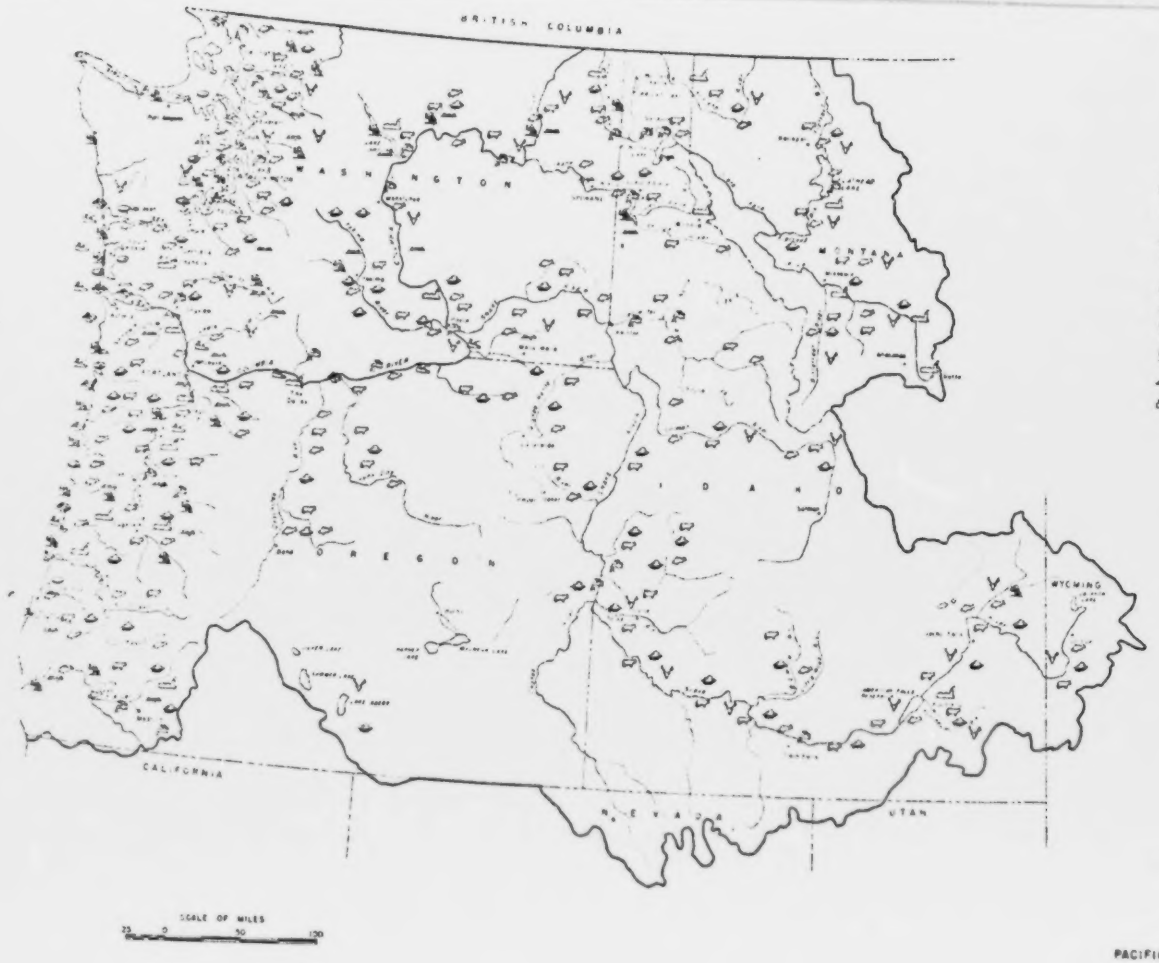
Public Health Service

DIVISION OF WATER POLLUTION CONTROL

MAP NO. 4

19-d

B



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PACIFIC NORTHWEST DRAINAGE BASINS

EXISTING PRIMARY WATER USES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 4

16818 O - 51 (Face p. 18) No. 4

SUB-BASIN REPORTS

KOOTENAI RIVER SUB-BASIN

Description and Economic Development

The Kootenai[1] River Sub-Basin is located in southeastern British Columbia, northwestern Montana and northern Idaho. The long axis of the sub-basin extends southerly from the vicinity of Lake Louise in British Columbia about 160 miles to the International Boundary and an additional 75 miles into Montana and Idaho. At the International Boundary the sub-basin is approximately 140 miles wide. The area is characterized by rugged mountains and narrow valleys through which the Kootenai and its 15 principal tributaries flow.

This report covers only the part of the sub-basin lying within the United States which is approximately one-fourth the total area of the sub-basin. Of this area 3,718 square miles are in Montana and 1,082 square miles are in Idaho. The sub-basin population was estimated to be 12,066 in 1947.

The natural resources consist of fertile valley lands, huge timber resources and mineral deposits. These have led to the chief economic pursuits of farming, lumbering and mining. Vermiculite, which is used for thermal and acoustic insulation, has become the sub-basin's most valuable mineral product in recent years.

Uses of Water Resources

The water resources of Kootenai River have not been utilized to any great extent. Six communities, serving approximately 60 percent of the sub-basin population, obtain their water supplies from surface sources. Other uses of the water resources are for irrigation, power production, recreation and fish and wildlife.

Summary of Water Pollution Data

Wastes, with a total population equivalent of approximately 4,000, are discharged to the sub-basin watercourses from 4,260 persons and 1 dairy. In addition, there are at least 4 lumber mills operating within the sub-basin.

Because of the lack of industrial development and the small urban population, pollution is not known to be serious, and the quality of the water apparently is satisfactory for all existing water uses.

Two of the three sewered municipalities are served by primary sewage treatment facilities. The other provides no treatment of its water. The existing septic tank at Bonners Ferry needs to be replaced at an estimated cost of $12,000. The treatment needs of the other two communities and the four lumber mills are undetermined.

Information on sources and amounts of pollution, treatment facilities, and treatment plant requirements is shown in Tables A_1 to L_1 inclusive.

Table A_1. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	3	4,260	4,074
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	0	Not applicable
Total	3	4,260	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1] Spelled Kootenay in Canada.

Table B_1. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	0	0
Producing organic wastes	0	Undetermined
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	4	Undetermined
Total	4	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_1.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	2	2	1,860
Secondary	0	0	0
No treatment	1	0	2,400

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_1. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Lumber and wood production	4	--	--	4

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_1. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	2	--	1	1	1	--	1
Industrial*	--	--	--	--	--	--	--

*Existing treatment facilities, if any, are undetermined.

Table F_1. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	0	--	Unknown	--

Table G_1. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	1	1,000	--
Enlargement or additions to existing plant	--	--	--
Replace existing plant	--	--	--
No project required	--	--	--
Undetermined	2	3,260	4

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

Table H_1. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	1	--
Abatement ordered	--	--
Plans under preparation	--	--
Final plans approved	--	--
Construction awaiting financing	--	--
Under construction	--	--
Status undetermined*	2	4

*Includes 2 municipalities and 4 industries appearing in Table G for which treatment needs are undetermined.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Bonners Ferry, Idaho.....	1,000	New plant	Type of treatment undetermined.

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

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CLARK FORK-PEND OREILLE RIVER SUB-BASIN

Description and Economic Development

The Clark Fork-Pend Oreille River Sub-Basin includes most of Montana west of the Continental Divide, a part of the panhandle of Idaho, a small area in the northeast corner of Washington and two separate areas in British Columbia. The drainage area of the sub-basin is 26,080 square miles, with 82 percent of the area in Montana, 8 percent in Idaho, 5 percent in Washington and 5 percent in British Columbia. The sub-basin is made up largely of conifer forested mountains lying on the western slope of the Rockies. The Clark Fork River flows into Pend Oreille Lake in Idaho which is also the source of the other main river of the sub-basin, the Pend Oreille. The latter discharges into the Columbia River just north of the International Boundary. Principal tributaries of Clark Fork River are Bitterroot, Blackfoot, St. Regis and Flathead Rivers, but Priest River is the only major tributary of the Pend Oreille River.

Natural resources of the sub-basin have tremendous developmental potentialities, but its mineral deposits, forests, agricultural lands and water resources have not yet been utilized extensively. In addition to the development of irrigation and hydroelectric power projects, mining and lumbering, people of the basin have created an industry of attracting and catering to tourists. Ideal summer climate, beautiful mountains, forests, streams and lakes lend themselves to this use. From an economic standpoint recreation perhaps is more valuable to the sub-basin than any other industry. The annual income from the tourist trade alone is estimated to be about 40 million dollars. The basin's 1947 population was estimated to be about 168,000.

Uses of Water Resources

Water resources of the basin are very substantial. Only about 2 percent of the available supply is used for irrigation, domestic, industrial and stock-watering purposes. Other uses of the water resources are for recreation, propagation of fish, wildlife, hydroelectric power and the transportation and booming of logs. Only 156,000 kilowatts of the sub-basin's estimated 5,000,000 kilowatts of potential hydroelectric power have been developed.

Summary of Water Pollution Data

Major pollution of the basin's watercourses is caused by discharge of raw and partially treated sewage from about 121,500 people and industrial wastes from mines, ore precipitation and reduction plants, a railroad shop, a beet sugar refinery and a variety of other industrial plants. There are 28 municipal and 27, or more, industrial sources of pollution. Known organic waste discharges from these sources are equivalent to a population of approximately 119,900. The amounts of inorganic waste discharges are undetermined.

Pollutional damages are confined, principally, to stretches of the Clark Fork River below Butte and Missoula, Mont.; stretches of the Pend Oreille River below Sandpoint, Idaho and Metaline Falls, Wash.; Whitefish Creek at Whitefish, Mont.; and Ashley Creek below Kalispell, Mont. Pollution of these watercourses has destroyed or interfered with their use for recreation and fish propagation, seriously impaired their use for irrigation, livestock and rural domestic purposes and created nuisance conditions with resulting losses in property values.

Municipal sewage treatment facilities, consisting mostly of septic tanks, serve 24 percent of the sewered population. Known requirements for prevention of pollution from municipal sources consist of: five new treatment plants in communities now discharging raw sewage; the replacement of septic tanks with modern type treatment facilities at five locations; and the enlargement of existing facilities and addition of secondary treatment at one location. The estimated cost of constructing these facilities is $833,600. Additional survey data are needed in order to determine the treatment requirements and estimate costs for fifteen municipalities.

Of the 27 industries discharging wastes directly to watercourses only two are known to have treatment facilities: At once the facilities are known to be inadequate and need to be replaced with a new plant. In addition, it has been determined that treatment facilities are needed at two other industries. The estimated cost of these three industrial waste

treatment construction projects is $100,000. The treatment requirements and estimated costs for 24 industries have not been determined.

Information on sources and amounts of municipal and industrial wastes, existing treatment facilities and treatment requirements is shown in Tables A_2 thru I_2 .

Table A_2. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	28	121,461	118,764
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	0	Not applicable
Total	28	121,461	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

Table B_2. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	3	1095
Producing organic wastes	10	Undetermined
Producing inorganic wastes	7	Not applicable
Producing wastes of undetermined type	7	Undetermined
Total	27	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_2.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	11	13	29,316
Secondary	0	0	0
No treatment	17	0	92,145

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_2. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products...	13	0	10	3
Other mining industries...	5	1	4	0
Lumber & wood products....	5	0	0	5
Miscellaneous.....	3	1	0	2
Products of petroleum.....	1	0	0	1
Totals.....	27	2	14	11

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_2. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	13	0	7	6	3	4	6
Industrial	2	0	1	1	0	0	2

Table F_2. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	0	--	Unknown	--

Table G_2. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	5[1]	6,495	2
Enlargement or additions to existing plant	1	11,000	0
Replace existing plant	5[2]	9,366	1
No project required	2	62,000	0
Undetermined	15	33,830	24

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes one plant serving 2 municipalities requiring treatment facilities. Includes one unsewered municipality with a population of 1,230 requiring both sewer system and treatment plant.

[2]Includes one plant to replace 3 existing septic tanks.

Table H_2. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	4	3
Abatement ordered	0	0
Plans under preparation	7	0
Final plans approved	0	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined*	15	24

*Includes 15 municipalities and 24 industries appearing in Table G for which treatment needs are undetermined.

Table I_2. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Hamilton, Mont.....	2000	New plant	Secondary treatment
Hot Springs, Mont.....	650	New plant	To be served by Hot Springs Resort Plant
Hot Springs Resort, Mont.....	2000	New plant	Hot Springs treatment plant
Newport, Wash.....	1230	New plant	Sewer system and treatment
Metaline Falls, Wash.....	315	New plant	---
Mont. State Tbc. Hospital....	300	New plant	Secondary treatment
Kalispell, Mont.....	11,000	Enlargement to existing plant	---
Whitefish, Mont.....	4000	Replace existing plant	Primary treatment
Sandpoint, Idaho.....	3500	Replace existing plant	Primary treatment
Ronan, Mont.....	900	Replace existing plant	Secondary treatment
Priest River, Idaho.....	650	Replace existing plant	---
Metaline Housing Project, Wash.....	316	Replace existing plant	---
Rendering Plant, Mont.....	Unknown PE	New plant[1]	Organic
G.N.R.R. Shops, Mont.....	Unknown PE	Replacement[1]	Chemical & domestic
Meat Rendering Plant, Mont...	Unknown PE	New plant[1]	Organic

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Treatment or process change to be determined by industry.

SPOKANE RIVER SUB-BASIN

Description and Economic Development

The Spokane River Sub-Basin includes an area of 6,640 square miles in northern Idaho and northeastern Washington. The sub-basin is roughly elliptical in shape with its major axis extending from the Bitterroot Mountains on the Idaho-Montana boundary to the junction of the Spokane and Columbia Rivers in Washington. Coeur d'Alene Lake, located in Idaho, receives drainage from the eastern half of the sub-basin but the Spokane River starts at the outlet on the north end of Coeur d'Alene Lake. Although originating in Idaho the Spokane River soon enters and flows through Washington for almost 100 miles before joining Franklin D. Roosevelt Lake on the Columbia River. About 67 percent of the sub-basins area is located in Idaho and 33 percent in Washington. The upper portion of the sub-basin is mountainous, the lower portion is rolling plateau and prairie lands. St. Joe and Coeur d'Alene Rivers are the principal tributaries of Coeur d'Alene Lake. Little Spokane River, Chamokane and Latah Creeks are tributaries of the Spokane River. The 1947 population of the basin was estimated to be 236,500.

Agricultural lands, forests, mineral deposits and water are of nearly equal importance in the basin's economy. These resources have been fairly well developed and have led to the intensive industrial development centered about Spokane, Wash.

Uses of Water Resources

Water has had an important part in the sub-basin's economic development. It supports one of the few public utilities in this country whose entire power facilities are hydroelectric. In addition, it provides recreation for thousands of people and encourages a tourist trade valued at 20 million dollars annually. It is also used to irrigate approximately 23,000 acres of land. Oth uses are for industrial and domestic wat supply, livestock, fish and wildlife. During the last 60 years periodic floods on the Coeur d'Alene River have caused extensive property damage, uprooted most of the wooded glades along the Upper South Fork and have washed much of the previously impounded tailings from ore concentration mills down the lower Coeur d'Alene valley.

Summary of Water Pollution Data

Major pollution of the Spokane Sub-Basin watercourses is caused by the discharge of raw sewage from about 165,500 people, treated sewage from 15,400 people, tailings from ore concentration mills, wastes from a sulphite pulp and paper mill and wastes from a variety of other industrial plants. Known organic waste discharges are equivalent to a population of 375,000. Over 1,000,000 tons of tailings from ore concentration mills are discharged to watercourses in the course of a year's time.

Polutional damages are confined principally to the South Fork of Couer d'Alene River below Mullan, Idaho; Coeur d'Alene River below the mouth of South Fork; and Spokane River below Millwood, Wash. Wastes from ore concentration mills entering some of these watercourses have affected the drinking water supply of Harrison, Idaho; destroyed all fish and aquatic life in the South Fork of Coeur d'Alene River below Mullan, Idaho and the Coeur d'Alene River below the mouth of South Fork. Pollution also has seriously impaired the value of the fishery in the Spokane River below Millwood, Wash.; retarded the development of recreational areas along Spokane River and created nuisance conditions at a number of locations. In addition, the possibility of mine tailing wastes affecting the water supply of Coeur d'Alene, Idaho must be recognized.

Municipal sewage treatment facilities now serve 8.5 percent of the total sewered population. Facilities under construction or being planned will when completed provide adequate treatment facilities for an additional 84 per cent. Construction of the known needed municipal treatment facilities at 11 locations and connection of the waste from 2 military bases to the City of Spokane sewerage system are estimated to cost $5,628,500.

Only 9 of 53 industries discharging wastes directly to watercourses are known to use waste prevention measures or provide waste treatment facilities. The adequacy of treatment provided at 8 of these plants is undetermined. Presently known industrial treatment requirements include only the construction of such facilities at one Industry at an estimated cost of $420,000. The treatment needs of the other 52 industries are undetermined.

Information on sources and amounts of pollution, existing treatment facilities and treatment needs is shown in Tables A_3 to I_3 inclusive.

Table A_3. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	16	178,374	197,731[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	6[2]	2,500[3]	Not applicable
Total	22	180,874	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strength and volume discharged to city sewers by 17 food industries not included.

[2]No information is available regarding strength and volume of wastes discharged to city sewers by 3 food industries.

[3]Sewered population of 4 military establishments not available.

Table B_3. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	6	174,341
Producing organic wastes	10	Undetermined
Producing inorganic wastes	30	Not applicable
Producing wastes of undetermined type	7	Undetermined
Total	53	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_3.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	1	1	2,186
Secondary	6	6	13,227[1]
No treatment	15	0	165,461[1]

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

[1]Sewered population of 2 municipalities not available.

Table D_3. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Other mining industries...	29	5	24	0
Food & kindred products...	15	0	5	10
Primary metal industries..	4	2	2	0
Paper & allied products...	1	1	0	0
Rolling, etc. nonfer. met.	1	1	0	0
Nonmetallic mining.....	1	0	0	1
Lumber & wood products....	2	0	0	2
Totals.....	53	9	31	13

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_3. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	7	7	0	0	6	1	0
Industrial	9	1	--	8	1	--	8

Table F_3. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	0	--	Unknown	--

Table G_3. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant [1]	13	167,431[2]	1
Enlargement or additions to existing plant	--	--	--
Replace existing plant	--	--	--
No project required	7	15,413[3]	--
Undetermined	3	30[4]	52

[1]Includes one unsewered municipality with a total population of 2000 requiring both sewer system and treatment plant.

[2]Sewered populations of 2 municipalities not available.

[3]Sewered populations of 2 municipalities not available.

[4]Estimated population of 3 housing projects at power plants on Lower Spokane River.

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

Table H_3. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	10	--
Abatement ordered	--	--
Plans under preparation	1	--
Final plans approved	--	--
Construction awaiting financing	--	--
Under construction	2[1]	--
Status undetermined [2]	3	53
Total	16	53

[1]Contracts awarded for construction of interceptor sewers at Spokane, Washington and for a secondary treatment plant at Tekoa, Washington. Final plans for the treatment plant at Spokane await additional financing.

[2]Includes 3 hydro-electric power dam housing developments and 52 industries appearing in Table G for which treatment needs are undetermined.

Table I_3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Spokane, Wash.	150,000	New plant	Primary treatment
Kellogg, Idaho.....	4,000	New plant	Primary treatment
Wallace, Idaho.....	3,800	New plant	Primary treatment
Mullan, Idaho.....	2,700	New plant	Primary treatment
St. Maries, Idaho.....	2,000	New plant	Primary treatment
Deer Park, Wash.	2,000	New plant	Sewer system and sec. treat.
Tekoa, Wash.	1,500	New plant	Secondary treatment
Wardner, Idaho.....	1,000	New plant	Primary treatment
Avery, Idaho.....	210	New plant	Primary treatment
Millwood, Wash.	181	New plant	Primary treatment
Harrison, Idaho.....	40	New plant	Primary treatment
Geiger Field, Wash.	1	New plant	Primary treatment[2]
Fort Geo. Wright, Wash.	1	New plant	Primary treatment[2]
Inland Empire Paper Co.	150,000	New plant	Sulfite waste liquor[3]

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Sewered population unknown.

[2]Military establishments which may connect with Spokane City treatment plant when completed.

[3]Treatment or process change to be determined by industry.

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YAKIMA RIVER SUB-BASIN

Description and Economic Development

The Yakima River Sub-Basin includes an area of 5,970 square miles in south central Washington. It is located on the east slope of the Cascade Mountain Range and in the lower Columbia River Plateau. The Yakima River flows for about 200 miles from its source on the eastern slopes of the Cascades to the Columbia River. Topography of the sub-basin ranges from extremely rough and irregular mountainous sections on the eastern Cascade slopes to rolling foothills and broad valleys along the main river and tributaries.

The economy of the sub-basin is based almost entirely upon irrigated agriculture. It is one of the oldest and most productive irrigated areas of the Pacific Northwest. About one-quarter of the total acreage in farms is irrigated and more than one million acre-feet of water storage has been provided to supplement natural flows for irrigating these lands. Mining of coal and lumbering are other important uses of the sub-basin's natural resources. The 1947 population of the sub-basin was estimated at 166,570.

Uses of Water Resources

Without the valuable water resources in the Yakima Sub-Basin, farming would be unprofitable. The annual income from irrigable lands without a water supply is much less than the annual income per acre from irrigated lands. Present diversions for irrigation result in extremely low flows in some stretches of the main river below Yakima during the late summer months. Other important uses of the sub-basin's water resources are for domestic, industrial and livestock watering supplies, fish and wildlife, hydroelectric power and recreation.

Summary of Water Pollution Data

Domestic sewage and wastes discharged by 17 municipal sewerage systems and 37 or more industrial plants not connected to city sewers are the major sources of pollution in the basin. The total known organic waste discharges are equivalent to a population of at least 97,300.

Pollution has been of much concern to residents of the Yakima Sub-Basin and to State and local health officials for many years. During the period 1907-1910 the death rate from typhoid fever was 150 per 100,000 population--about three times the average for the entire United States. Since that time many improvements in sanitation have been made and the incidences of typhoid fever have greatly decreased. Other water-borne diseases, however, have continued at higher rates than elsewhere in the State of Washington. As recently as 1945 an outbreak of enteric diseases occurred. The rate per 100,000 population for these diseases during that year was 112.3--about four times the average for the State as a whole.

It is believed by Washington State officials and others that the discharge of partially treated domestic sewage into watercourses above irrigation canal diversions contributes to the high rates of enteric diseases prevalent in the sub-basin. These canals spread the water over large areas of land on which vegetable and fruit crops are grown. Shallow ground waters used as sources of drinking supply by many rural people are contaminated in these areas. The highest enteric disease rates are found in the Yakima Valley below Yakima.

In order to protect the valuable water resources, 84,200 people living in 15 of the 17 sewered communities have invested in sewage treatment plants costing more than $2,500,000. Some of these plants have been found inadequate to handle the unexpected heavy industrial and domestic sewage loads that are now imposed upon them. As a result of these conditions, which are most serious during the low stream flow period, pollution still remains an important factor in the health and welfare of people living in the sub-basin.

Municipal treatment needs include: sewage treatment plants for two locations that are now without treatment facilities, the installation of complete sewerage systems in two locations, and enlargement or additions to existing treatment facilities at six locations, and the replacement of existing facilities at one location. The estimated cost of constructing these facilities is $1,250,000. In two municipalities the industrial waste discharges to the sewerage system must be reduced to allow for adequate operation of existing municipal treatment plants.

Only 11 of the 37 industries discharging wastes directly to watercourses are known to provide some degree of waste treatment prior to discharge. Treatment needs of all thirty-seven industrial plants are undetermined.

Information on sources and amounts of municipal and industrial pollution, existing treatment plants and requirements for new plants is shown in Tables A_4 to L_4 inclusive.

Table A_4. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	16	85,995	74,645
Having population data available (Data on pollution load to watercourse incomplete or not available)	1[1]	3,500	Not applicable
Total	17	89,495	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]No information is available regarding strength and volume of wastes discharged to city sewers by 3 food industries.

Table B_4. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	10	19,168
Producing organic wastes	19	Undetermined.
Producing inorganic wastes	8	Not applicable.
Producing wastes of undetermined type	0	Undetermined.
Total	37	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_4.
Existing treatment facilities, municipal*

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	7	7	48,736
Secondary	8	8	35,459
No treatment	2	0	5,300

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_4. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products...	29	7	6	16
Stone, clay & glass products.....	2	0	0	2
Nonmetallic mining & quarring.....	4	2	0	2
Bituminous & other soft coal.....	1	1	0	0
Other mining industry.....	1	1	0	0
Totals.....	37	11	6	20

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_4. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	15	10*	5	0	10	5	0
Industrial	11	--	--	11	--	--	11

*Includes two treatment plants where existing facilities have adequate capacity, but additional facilities are needed to provide a higher degree of treatment. These needs are reflected in Table G_4

Table F_4. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	150	Unknown	--
1947	1	3,000	Unknown	--
1948	0	--	Unknown	--
1949	2	4,700	Unknown	--

Table G_4. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant [1]	4	9,100	--
Enlargement or additions to existing plant	6	50,436	--
Replace existing plant	1	300	--
No project required	8	33,459	--
Undetermined	0	0	37

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes two unsewered municipalities with a total population of 3800 requiring both sewer systems and treatment plants.

Table H_4. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	5	--
Abatement ordered	0	--
Plans under preparation	2	--
Final plans approved	1	--
Construction awaiting financing	0	--
Under construction	3	--
Status undetermined *	0	37

*Includes 37 industries appearing in Table G for which treatment needs are undetermined.

Table I4. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Toppenish	3,500	New plant	Secondary treatment
Union Gap	3,000	New plant	Sewer system and secondary treatment (under construction)
Cle Elum	1,800	New plant	Primary treatment
Kittitas	800	New plant	Sewer system and secondary treatment (under construction)
Yakima	34,000	Additional treatment	Chlorination needed
Ellensburg	7,152	Additional treatment	Secondary treatment
Wapato	2,384	Enlargements & additions	Enlargement & secondary treatment
Selah	2,000	Enlargements & additions	Enlargement & secondary treatment (under construction)
Zillah	584	Enlargements & additions	
Roslyn	1,700	Enlargement	Primary treatment
Moxee	300	Replace existing plant	Secondary treatment
Sunnyside	3,200	No project required	Reduce industrial load
Grandview	2,125	No project required	Reduce industrial load

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

COLUMBIA RIVER SUB-BASIN ABOVE YAKIMA RIVER

Description and Economic Development

The Columbia River Sub-Basin above the Yakima River includes all of the area draining into the Columbia River below the Canadian border and above the mouth of the Yakima River but excludes the Spokane River drainage. The sub-basin is 190 miles long, 145 miles wide and covers an area of 21,325 square miles. The entire area lies within the northern and central parts of eastern Washington. The area north of the Spokane River and west of the Columbia is mountainous while that south and east is composed of plateaus, large basins and low foothills. The latter area is commonly known as the Columbia Plateau. Eight principal tributaries feed the Columbia River within this sub-basin. Two of these rivers originate in Canada and drain large areas there. The Columbia River, which enters the United States from Canada in the northeast corner of Washington, flows about 415 miles in southerly and westerly directions through the sub-basin. Grand Coulee Dam is located on the Columbia about 150 miles below the Canadian Boundary.

Agricultural lands, forests, minerals and water are of tremendous importance to the sub-basin's present and future economic growth. Agriculture currently is the chief economic activity of the sub-basin, although lumbering and mining are also of importance. About 45 percent of the sub-basin area is forested; known deposits of minerals exist in most of the mountainous sections, and only 4 percent of the agricultural lands, including only a small portion of the Columbia Basin Irrigation Project, are presently irrigated. It is expected therefore that future industrial expansion including agriculture will be great. The availability of hydroelectric power at Grand Coulee Dam and from Chief Joseph Dam, now under construction, together with an available water supply for irrigation of more than one million additional acres of land, are reasons for this expected expansion. The movement toward industrial growth in the area already is indicated by community growth and other activities in the Columbia Basin Irrigation Project now under construction and by developments of the Atomic Energy Commission at Hanford.

Uses of Water Resources

Future economic growth of the basin is tied in with its abundant water resources. Generation of power at hydroelectric plants and irrigation are the primary planned uses to be made of the water. However, there is no knowledge at present of the number of industries similar to the Hanford Atomic Energy Plant that will locate in this area. This plant requires tremendous quantities of clean water in its operations. Certain types of wastes entering the Columbia River above the atomic energy plant water intake could be a serious handicap in the processing of radioactive materials. For this reason studies are needed on irrigation return flows in the Columbia Basin Irrigation Project and on other polluting wastes that could enter the river from this project's development.

Of lesser importance at the present time are the uses of the sub-basin's water resources for domestic, industrial and livestock supply, recreation, fish and wildlife. However, development of the irrigation project will result in increased importance of water resources for these uses.

The 1947 population of the sub-basin was estimated to be 109,500. Development of the one million acre Columbia Basin Irrigation Project is expected to increase the population of the sub-basin by at least 100,000.

Summary of Water Pollution Data

Present organic pollution of the sub-basin's watercourses is not great in comparison with other sub-basins in the Pacific Northwest. Twenty-eight of the 30 municipal sources of pollution in the sub-basin are known to discharge wastes with a population equivalent of more than 34,000. There are 39 wastes industries known to be discharging wastes directly to watercourses. Twenty-five of these discharge organic wastes, 10 discharge inorganic wastes, and the type of wastes discharged by 4 plants has not been determined. The amount of pollution contributed to the watercourses is undetermined for all but three of these industries. These three plants discharge wastes equivalent to a population of approximately 2,600.

Pollution damages occur principally on streams where dry weather flows are negligible, such as those in the Columbia River Plateau areas, as also on some of the larger rivers and lakes where mining wastes and raw sewage are discharged. Present information on the Hanford Atomic Energy plant indicates that the concentration of radioactive materials in wastes discharged by that plant are at present below established tolerance standards. The occasional discharge of mining

wastes in the Similkameen River and Rattlesnake Creek has created pollution problems.

Twenty-five of the 30 sewered municipalities in the sub-basin have sewage treatment plants serving about 62 percent of the sewered population. About one-third of the municipal plants have waste treatment facilities. Ten of the 39 industrial plants provide inadequate treatment. The adequacy of these facilities is as yet undetermined.

The known requirements for treatment of municipal wastes include six new plants, the enlargement of one plant and the replacement of seven of the existing plants. Three municipalities have plans for sewage treatment plants underway, one has already received approval of its final plans and another has a plant under construction. The estimated cost for construction of the municipal waste treatment facilities is $1,500,000. Industrial waste treatment requirements are undetermined.

Information on sources and amounts of municipal and industrial wastes, treatment facilities and known requirements for pollution abatement is shown in Tables A_5 to I_5 inclusive.

Table A_5. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people) **
Having data on pollution load discharged to watercourse	28	49,232	34,419[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	2[2]	2,512	Not applicable
Total	30	51,744	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strength and volume discharged to city sewers by 10 food industries not included in total.

[2]No information is available regarding strength and volume of wastes discharged to city sewers by 5 food industries.

Table B_5. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	3	2,568
Producing organic wastes	22	Undetermined.
Producing inorganic wastes	10	Not applicable.
Producing wastes of undetermined type	4	Undetermined.
Total	39	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_5.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	16	16	19,894
Secondary	9	9	12,075
No treatment	5	0	19,775

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_5. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products...	25	1	1	23
Stone, clay & glass products	3	2	0	1
Other mining industries...	7	7	0	0
Lumber & wood products....	3	0	0	3
Atomic energy.....	1	0	0	1
Totals.....	39	10	1	28

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_5. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	25	16	8	1	17	7	1
Industrial	10	--	--	10	--	--	10

Table F_5. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	100	Unknown	--
1947	2	7,500	Unknown	--
1948	2	19,320	Unknown	--
1949	4	17,700	Unknown	--

Table G_5. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant **	6	22,275	-
Enlargement or additions to existing plant	1	400	-
Replace existing plant	7	7,792	-
No project required	16	23,702	-
Undetermined	1	75	39

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

**Includes one unsewered municipality with a total population of 2500 requiring both sewer system and treatment plant.

Table H_5. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	8	-
Abatement ordered	0	-
Plans under preparation	3	-
Final plans approved	1	-
Construction awaiting financing	0	-
Under construction	1	-
Status undetermined *	2	39

*Includes 1 municipality & 39 industries appearing in Table G for which treatment needs are undetermined.

Table I_5. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Wenatchee	13,000	New plant	Primary treatment
Colville	2,800	New plant	Secondary treatment, under construction
Grand Coulee	2,000	New plant	Primary treatment
East Wenatchee	1,375	New plant	Primary treatment
Brewster	2,500	New plant	Complete sewer system and primary treatment
Lind	600	New plant	Primary treatment
Chewelah	1,800	Replacement of existing plant	Secondary treatment
Ritzville	1,800	Replacement of existing plant	Secondary treatment
Cashmere	1,662	Replacement of existing plant	Secondary treatment
Coulee City	900	Replacement of existing plant	Type undetermined
Harrington	500	Replacement of existing plant	Secondary treatment
Reardon	380	Replacement of existing plant	Secondary treatment
Waterville	750	Replacement of existing plant	Type undetermined
Quincy	400	Enlargement	—

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

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UPPER SNAKE RIVER SUB-BASIN

Description and Economic Development

The Upper Snake River Sub-Basin includes all of the area draining into the Snake River above King Hill, Idaho. Of a total area of 35,800 square miles, 80 percent lies in southeastern Idaho, 14 percent in northwestern Wyo., four percent in northeastern Nev. and the remainder in northwestern Utah. The sub-basin is surrounded by mountain ranges, with a western gap through which the Snake River flows. The Snake River Plain covers a major part of the central portion of the sub-basin. Rising in the southern part of Yellowstone National Park, the Snake River flows in a westerly and southerly direction for more than 500 miles before reaching King Hill, Idaho. Several important tributaries flow into the Snake in this stretch. The waters of some of the streams percolate underground into porous lava deposits, reaching the Snake River in the lower part of the sub-basin at Thousand Springs.

The 1947 population of the sub-basin was estimated to be 202,000.

Of the approximately 23 million acres of land in the sub-basin, about one-fourth are agricultural and one-half range land. Much of the remaining land is of recreational character and consists of areas lying within the boundaries of Yellowstone and Grand Teton National Parks, U. S. Forest Service primitive areas, and in wastelands. The prime resources of the sub-basin are its agricultural lands and the water used for their irrigation. Other resources of relatively minor importance include minerals, recreational areas and game animals. The economy of the sub-basin depends upon the irrigation of the arid and semi-arid lands without which large areas could not be farmed profitably. Approximately 1,560,000 acres, or one-third of the farm lands in the sub-basin, are irrigated. Gross farm income is in excess of 100 million dollars annually. Next to agriculture and its associated processing industries, recreation is probably of the greatest economic importance. The proximity of Yellowstone National Park, the many primitive hunting and fishing areas, and the mountain storage reservoirs attract large numbers of tourists to the sub-basin each year.

Uses of Water Resources

Because of a lack of conservative water use and the lack of adequate water storage on the streams, the sub-basin's water resources are not presently being utilized to their fullest extent. Shortages in the irrigation supply occur during the late months of the irrigation season. During this period stream flows are usually depleted and other water uses affected. Nearly four million acre feet of storage has been provided and other storage projects are proposed to correct these deficiencies. Principal uses of the sub-basin's water resources, other than for irrigation, are for domestic, industrial and livestock supply, recreation, hydroelectric power and propagation of fish and wildlife.

Summary of Water Pollution Data

Pollution of the sub-basin's watercourses is most severe during periods of low stream flow. It is caused by the discharge of raw and partially treated wastes from 21 municipalities and the wastes from 25 or more industries which discharge direct to watercourses. Known organic waste discharges are equivalent to a population of 904,700 persons or more than four times the sub-basin's population.

During periods of low flow sufficient water is not available for dilution and natural purification purposes. As a result, water diverted at some points for irrigation is polluted and that left in the streams is inadequate for recreational use and propagation of fish.

Ten of the 21 municipalities have treatment facilities which serve about one-fifth of the total sewered population of the sub-basin. About half of these municipal treatment plants are of inadequate capacity. None of the 25 industries are known to have waste treatment facilities.

The known requirements for waste treatment facilities include 10 new municipal and 11 industrial plants, the enlargement of seven municipal plants and the replacement of one municipal plant with modern treatment facilities. Requirements for one municipality and 14 industries are undetermined. Plans are being prepared for the construction of municipal plants in four locations. The estimated cost of constructing the needed municipal treatment plants is $3,100,000 and for construction of the industrial plants is $2,150,000.

Information on sources and amounts of pollution, treatment facilities and requirements for new treatment plants is shown in Tables A_6 to I_6 inclusive.

Table A_6. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	21	72,888	139,300[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	0	Not applicable
Total	21	72,888	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strength and volume discharged to city sewers by 6 food industries not included.

Table B_6. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	10	765,400
Producing organic wastes	11	Undetermined
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	4	Undetermined
Total	25	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_6.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	10	10	15,463
Secondary	0	0	0
No treatment	11[1]	0	57,425

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers; industries discharging sanitary sewage wastes directly to watercourse.

[1]Includes 1 municipality with treatment facilities unknown.

Table D_6. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.	21	0	11	10
Chemical and allied products.....	2	0	0	2
Products of petroleum.....	1	0	0	1
Other mining industries...	1	0	0	1
Total.....	25	0	11	14

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_6. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	10	4*	5	1	5	4	1
Industrial	0	0	0	0	0	0	0

*Includes 2 treatment plants where existing facilities have adequate capacity, but additional facilities are needed to provide a higher degree of treatment. These needs are reflected in Table G_6

Table F_6. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	0	Unknown	--
1947	0	0	Unknown	--
1948	1	2000	Unknown	--
1949	0	0	Unknown	--

Table G_6. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	10	57,050	11
Enlargement or additions to existing plant	7	11,263	0
Replace existing plant	1	2,000	0
No project required	2	2,200	0
Undetermined	1	375	14

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

Table H_6. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	13	0
Abatement ordered	0	0
Plans under preparation	4	0
Final plans approved	0	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined [1]	2	25

[1]Includes 1 municipality and 14 industries appearing in Table G_6 for which treatment needs are undetermined.

Table I_6. Project list - municipalities and industries requiring improvements for abatement of pollution[1], July 1, 1950

Name	Population served	Project requirements	Remarks
Pocatello, Idaho.....	17,000	New plant	Primary treatment
Idaho Falls, Idaho.....	11,000	New plant	Primary treatment
Twin Falls, Idaho.....	10,000	New plant	Primary treatment
Blackfoot, Idaho.....	5,000	New plant	Primary treatment plant outfall-Ext. trunk system
Burley, Idaho.....	4,500	New plant	Primary treatment
Rexburg, Idaho.....	2,550	New plant	Primary treatment
Buhl, Idaho.....	2,300	New plant	Primary treatment
Shelley, Idaho.....	1,800	New plant	Primary treatment
St. Anthony, Idaho.....	1,700	New plant	Primary treatment
American Falls, Idaho.....	1,200	New plant	Primary treatment
Rupert, Idaho.....	3,100	Enlargement of plant	Primary treatment
Ashton, Idaho.....	1,050	Enlargement of plant	Primary treatment
Aberdeen, Idaho.....	800	Enlargement of plant	Primary treatment
Filer, Idaho.....	700	Enlargement of plant	Primary treatment
Jerome, Idaho.....	2,700	Additional treatment methods required	Secondary treatment
Rigby, Idaho.....	1,500	Addition to existing plant	Outfall required
Sun Valley, Idaho.....	2,000	Replace existing plant	Secondary treatment
Afton, Wyo.....	1,413	Enlargement and addition	Secondary treatment
Utah-Idaho Sugar Co.....	70,000	New plant[2]	Organic wastes
Utah-Idaho Sugar Co.....	79,000	New plant[2]	Organic wastes
Utah-Idaho Sugar Co.....	89,000	New plant[2]	Organic wastes
Idaho Potato Starch Co.....	21,000	New plant[2]	Organic wastes
Amalgamated Sugar Co.....	132,000	New plant[2]	Organic wastes
Roger Bros. Potato Flour.....	22,000	New plant[2]	Organic wastes
Amalgamated Sugar Co.....	327,000	New plant[2]	Organic wastes
Magic Valley Processing Co....	14,500	New plant[2]	Organic wastes
Idaho Products, Inc.....	Unknown	New plant[2]	Glucose manufacture organic wastes
Idaho Products,.Inc.....	2,800	New plant[2]	Potato starch manufacture organic wastes
St. Anthony Starch Plant.....	7,500	New plant[2]	Organic wastes

[1]The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[2]Treatment or process change to be determined by industry.

Note: All industrial plants located within the State of Idaho.

CENTRAL SNAKE RIVER SUB-BASIN

Description and Economic Development

The Central Snake River Sub-Basin includes all of the area draining to the Snake River between King Hill, Idaho and Hell's Canyon some 12 miles below Weiser, Idaho. A little more than half of the 34,300 square miles in this area is within the State of Idaho, with 35 percent in Ore. and 12 percent in Nev. The Idaho-Oregon State line crosses the middle of the sub-basin. The sub-basin, although a plain in the center, is surrounded by mountains with peaks exceeding 10,000 feet. In flowing through the eastern part of the Snake River Plain, the river drops from 2,500 feet at King Hill to 2,085 feet at the canyon entrance below Weiser. Along the 205 miles of its northwesterly course it traverses fertile lands in a highly developed area Six principal tributaries enter the Snake River in this stretch. Originating in the mountains, they bring water as far as 300 miles to the Snake through narrow gorges, lava canyons and widened valleys.

Fertile lands and the water required to make them productive are the basic resources of the area. Although they exceed in importance the vast forests, range lands and scattered minerals deposits, the latter provide balance to the sub-basin's economy. Less than one-twentieth of the 22 million acres in the sub-basin are used for growing crops, but more than 17 million acres of open range and forest are available for grazing. The 800,000 acres of irrigated land form the operational center of the entire agricultural effort and, in the same way, some 2 1/2 million acres of saw-timber stands form the basis of the lumbering industry. Mineral deposits are scattered and of great variety, but the mining industry has not been of great importance in the sub-basin's economy. The population of the sub-basin is heavily concentrated where fertile land and water exist. Seventy-eight percent of the estimated 1947 population of 159,000 reside in the triangular area bounded roughly by Boise and Weiser, Idaho, and Vale, Ore.

Uses of Water Resources

Use of the water resources on the farm is the greatest of all water uses. For the irrigation of 800,000 acres and watering of thousands of head of stock, the tributaries of Snake River are intensely utilized. Reservoirs on the principal tributaries store about three million acre-feet of water to supplement natural flows in providing the irrigation supply. During dry years all available flows in some streams are diverted for irrigation. Such waters, containing raw sewage from a number of municipalities, are diverted into the irrigation canals and eventually to farm lands so that pollution is greatest during the dry months of the year. Four municipalities have found it more convenient to draw upon underground sources rather than surface sources for their domestic supply. Other uses of the sub-basin's water resources are for industrial supply, hydroelectric power, propagation of fish, wildlife and recreation.

Summary of Pollution Data

Serious pollution exists in the highly populated irrigated valleys. It results from (1) the discharge of raw sewage by a number of municipalities in the area, and (2) the seasonal discharge of great quantities of wastes from beet sugar refineries and other food processing plants. The known organic wastes discharged to the watercourse in the sub-basin are equivalent to a population of not less than 822,000. In addition the amount of organic wastes discharged by 10 industries and the inorganic waste discharged by 2 industries are undetermined.

There are 22 municipalities and 31 industries discharging wastes into watercourses of the sub-basin. Twelve of the municipalities and six industries have treatment facilities. New secondary treatment plants were constructed at Boise and Nampa, Idaho in 1949 and are now in operation. Nine of the existing municipal waste treatment plants are inadequate for treatment of the domestic wastes.

Presently known treatment requirements for the basins include 10 new municipal and two industrial waste treatment plants, the enlargement of four municipal plants and the replacement of five existing municipal plants with modern sewage treatment facilities. The requirements of 28 industries have not been determined.

The estimated cost of constructing the known needed municipal treatment facilities including interceptor sewers is $1,760,000. The construction of treatment facilities at the two industrial plants where requirements have been determined is estimated to cost $300,000.

Information on the sources and amounts of municipal sewage and industrial wastes, existing treatment facilities and treatment requirements is shown in Tables A_7 to I_7 inclusive.

Table A_7. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	22	68,350	61,701
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	--	--
Total	22	68,350	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

Table B_7. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	19	760,450
Producing organic wastes	10	Undetermined
Producing inorganic wastes	2	Not applicable
Producing wastes of undetermined type	0	Undetermined
Total	31	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_7
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	9	9	6,350
Secondary	3	3	38,000
No treatment	10**	0	24,000

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes 1 unsewered community with a total population of 2,000 requiring both a sewer system and treatment facilities.

Table D_7. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products..	29	6	14	9
Other mining industries..	2	0	1	1
Totals.....	31	6	15	10

*Industries having separate outlets and discharging wastes directly to watercourse

Table E_7. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	12	3	9	0	5	6	1
Industrial	6	--	--	6	--	--	6

Table F_7. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	2	37,000	Unknown	--

Table G_7. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	10**	24,000	2
Enlargement or additions to existing plant	4	17,050	0
Replace existing plant	5	2,050	0
No project required	3	27,050	1
Undetermined	0	0	28

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

**Includes 1 unsewered municipality with a total population of 2,000 requiring both sewer system and treatment plant.

Table H_7. Status of treatment work projects to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	14	0
Abatement ordered	0	0
Plans under preparation	6	0
Final plans approved	0	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined[1]	0	30

[1]Includes 28 industries appearing in Table G for which treatment needs are undetermined.

Table I-7. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Caldwell, Idaho.....	6,000	New plant	Secondary treatment
Vale, Oreg.	1,000	New plant	Secondary treatment
Ontario, Oreg.	3,500	New plant	Primary treatment
Weiser, Idaho.....	3,500	New plant	Primary treatment
Emett, Idaho.....	3,100	New plant	Primary treatment
Payette, Idaho.....	2,500	New plant	Primary treatment and new sewer system
Marsing, Idaho.....	2,000	New plant	Primary treatment and sewer system
Cascade, Idaho.....	1,200	New plant	Primary treatment
Parma, Idaho.....	800	New plant	Primary treatment
Fruitland, Idaho.....	600	New plant	Primary treatment
Nampa, Idaho.....	12,000	Additions	Additional interceptors and lateral sewers
Mountain Home, Idaho.....	2,000	Enlargement of existing plant	--
Nyssa, Oreg.	1,800	Enlargement of existing plant	Primary treatment plant never completed because of lack of funds
Cambridge, Idaho.....	250	Enlargement of existing plant	--
McCall, Idaho.....	600	Replacement of existing plant	Primary treatment plant
Homedale, Idaho.....	550	Replacement of existing plant	Primary treatment
Council, Idaho.....	450	Replacement of existing plant	Primary treatment plant
Notus, Idaho.....	250	Replacement of existing plant	Secondary treatment
Eagle, Idaho.....	200	Replacement of existing plant	Secondary treatment
Boise Valley Packing Company, Eagle, Idaho.....	768	New plant[1]	Organic wastes
Amalgamated Sugar Company, Nyssa, Oreg.	586,400	New plant[1]	Organic wastes

[1]Treatment or process change to be determined by industry.

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

MIDDLE AND LOWER SNAKE RIVER SUB-BASIN

Description and Economic Development

The sub-basin of the Middle and Lower Snake is a very irregularly shaped area of about 40,000 square miles occupying the central part of Idaho, the northeastern corner of Oregon and the southeastern corner of Washington. Of this area 63 percent is in Idaho, 21 percent in Oregon and 16 percent in Washington. The irregularity of the sub-basin is caused by the complexity of the mountain systems which determine the direction of drainage from the sub-basin boundaries. The Snake River enters the sub-basin near the southwest boundary on the Idaho-Oregon line and flows north to Lewiston, Idaho and then southwesterly for 350 miles to its junction with the Columbia River at Pasco, Washington. Major tributaries are the Salmon, Grande Ronde and Clearwater Rivers. The sub-basin has three distinct types of topography. The northwest section has wide expanses of fairly flat lands devoid of mountains, but possessing shallow canyons along the drainage courses. Adjoining is a foothill area characterized by wide valleys and timber-topped hills. Mountainous regions occupy the greatest area and are extremely rough and generally covered with timber. Between the Blue Mountains to the east, the Snake River flows through mile-deep Hell's Canyon which, though inaccessible through lack of roadways, rivals the Grand Canyon of the Colorado in depth and variety of erosional features. The Salmon River, known also as the "River of No Return", flows through narrow valleys and deep canyons throughout much of its length. Because of the rugged terrain, both the Snake River in this sub-basin and certain sections of the Salmon River are the most extensive, inaccessable and primitive areas of the United States. The 1947 population of the sub-basin was estimated at 165,000 distributed about equally between farms and small towns.

The principal resources of the sub-basin are agricultural lands, forests, minerals and recreational and wildlife areas. Agriculture is the chief economic activity with a gross area income of more than 100 million dollars annually derived principally from wheat and peas grown on dry-farmed land. Lumbering and mining also are important activities. Manufacturing is on a very limited scale. Although recreation at present is not of great economic importance, its future offers unlimited possibilities.

Uses of Water Resources

The Middle and Lower Snake River Sub-Basin is one of major importance to the anadromous fishes in the Pacific Northwest. The fish that spawn here are an important part of the commercial fishery of the lower Columbia River, the ocean trawl and an extensive sports fishery. In addition to their use for fish propagation, water resources of the basin are used for the irrigation of 342,700 acres of land, mostly by gravity from natural flows in the stream; for the domestic water requirements of more than 150,000 people, one third of which are served from surface sources; and for industrial and livestock supply, recreation, wildlife, hydroelectric power and limited navigation.

Potential development of the sub-basin water resources includes four dams on the lower Snake River for navigation and power production, and the Hell's Canyon Dam which would impound 3,280,000 acre-feet of water. This water would be used for production of power and river flow regulation.

Summary of Water Pollution Data

Major pollution is caused by the discharge of municipal and industrial wastes into streams tributary to the Snake River. Sub-basin watercourses receive raw or partially treated wastes from 29 municipalities serving a total population of about 62,700 and wastes from 21 industrial plants discharging directly to the watercourses. The known population equivalent of these organic wastes is about 58,000. Although it includes only 2 of the 12 industrial sources of organic wastes being discharged directly to watercourses, these 2 are believed to be the major sources of this type of industrial pollution. In addition there are wastes from dredge and other mining operations.

Of the 29 municipalities, 15, located mostly on small tributary streams, have installed treatment facilities of which 10 are known to to be of insufficient capacity. Five of the industries have installed treatment facilities of which 2 are known to be operated unsatisfactorily.

Known waste treatment requirements include the construction of new plants by 15 municipalities, the enlargement of 3 municipal plants, the replacement of 8 municipal plants with modern type facilities and the replacement of 2 of the existing industrial waste treatment plants. Treatment requirements of 19 industries have not been determined. The estimated cost of construction of the municipal plants is $1,667,600. Replacement of the industrial treatment facilities is estimated to

cost $50,000. Four of the municipalities are preparing plans for new plants, one has final plans completed and 2 have plants under construction.

Table A_s. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	27[1]	58,923	34,940[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	2[2]	3,750	Not applicable
Total	29	62,673	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strengh and volume discharged to city sewers by 4 food industries not included.

[2]No information is available regarding strength or volume of wastes discharged to city sewers by 4 food industries.

Information on sources and amounts of pollution, treatment facilities and requirements for new plants is included in Tables A_s to I_s inclusive.

Table B_s. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	2	19,296
Producing organic wastes	10	Undetermined
Producing inorganic wastes	9	Not applicable
Producing wastes of undetermined type	0	--
Total	21	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_s.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	9	9	13,045
Secondary	6	6	31,510
No treatment	14	0	18,118

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_s. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.....	12	5	--	7
Other mining industries..	9	--	--	9
Total.....	21	5	--	16

*Industries having separate outlets and discharging wastes directly to watercourse.

Table Eg. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	15	4	10	1	6	8	1
Industrial	5	--	--	5	--	2	3

Table Fg. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	--	--	Unknown	--
1947	--	--	Unknown	--
1948	--	--	Unknown	--
1949	1	6,200	Unknown	--

Table Gg. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	15[1]	18,718	--
Enlargement or additions to existing plant	3	10,810	--
Replace existing plant	9	13,545	2
No project required	3[2]	20,200	--
Undetermined	0[3]	--	19

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 1 unsewered municipality with a total population of 600 requiring both sewer systems and treatment plant.

[2]Does not include 1 plant appearing in Table Eg under "Capacity Satisfactory" as higher degree of treatment is required.

[3]Does not include 1 plant appearing in Table Eg under "Capacity Undetermined" as higher degree of treatment is required.

Table Hg. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	20	--
Abatement ordered	0	--
Plans under preparation	4	--
Final plans approved	1	--
Construction awaiting financing	0	--
Under construction	2	--
Status undetermined[1]	0	21

[1]Includes 19 industries appearing in Table G for which treatment needs are undetermined.

Table Ig. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1,1950

Name	Population served	Project requirements	Remarks
Lewiston, Idaho.....	10,000	New plant	Primary treatment needed
Clarkstone, Wash.	3,000	Replace existing plant	Primary treatment required (under construction)
Orofino, Idaho.....	1,500	New plant	Primary treatment needed
Union, Oreg.	1,200	New plant	Secondary treatment needed
Huntington, Oreg.	750	New plant	Secondary treatment needed
Nezperce, Idaho.....	700	New plant	Secondary treatment needed
Potlatch, Idaho.....	650	New plant	Secondary treatment needed
Medical Lake, Wash.	600	New plant	Sewer system and complete treatment
Cottonwood, Idaho.....	600	New plant	Secondary treatment needed
Salmon, Idaho.....	600	New plant	Primary treatment needed
Palouse, Wash.	500	New plant	Secondary treatment needed
Troy, Idaho.....	464	New plant	Secondary treatment needed
Elk River, Idaho.....	337	New plant	Primary treatment needed
Kedrick, Idaho.....	337	New plant	Primary treatment needed
Headquarters, Idaho.....	250	New plant	Primary treatment needed
Bovill, Idaho.....	230	New plant	Primary treatment needed
LaGrande, Oreg.	7,500	Additions	Final clarifier, sludge digester, etc. needed
Colfax, Wash.	3,060	Additions	Cl. contact tank and heating for digester needed (under construction)
Genesee, Idaho.....	250	Additions and enlargement	Secondary treatment needed
E State Hosp. Wash.	2,220	Replace existing plant	Primary treatment with use of lake as an oxidation pond.
Pomeroy, Wash	1,900	Replace existing plant	Secondary treatment required
Lakeland Village, Wash.	1,600	Replace existing plant	Primary treatment with use of lake as an oxidation pond
Grangeville, Idaho.....	1,600	Replace existing plant	Secondary treatment needed
Enterprise, Oreg.	1,500	Replace existing plant	Secondary treatment needed
Garfield, Oreg.	750	Replace existing plant	Secondary treatment needed
Oaks Dale, Wash.	525	Replace existing plant	Secondary treatment needed
Rosalia, Wash.	450	Replace existing plant	Secondary treatment needed
Eastern Oregon Meat Co., Oreg.	0	Replace existing plant[1]	Nuisance because of land disposal
Baker Packing Co. Oreg.	0	Replace existing plant[1]	Nuisance because of land disposal

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Treatment or process change to be determined by industry.

WILLAMETTE RIVER SUB-BASIN

Description and Economic Development

The Willamette River Sub-Basin is a rectangular drainage trough 150 miles long and about 75 miles wide lying between the Cascade and the Coast Ranges in northwestern Oregon. The run-off from its 11,200 square miles of mountain slopes, gentle hills and valley floor flows northward to the Columbia River near Portland. The Willamette River, fourth in volume of flow among the Columbia River tributaries, receives drainage from many tributaries ranging in size from small mountain streams to large rivers.

Forests cover 62 percent of the basin area and will provide for a sustained annual yield of 1.7 billion board feet of timber. Thirty thousand farms that cover 2 million acres produce 100 million dollars worth of utility and specialty crops annually. Scenic areas, fish and wildlife and facilities for recreation make the tourist business the third largest industry of the basin. The 1947 population of the basin was estimated to be 843,600.

Uses of Water Resources

Economic development has progressed favorably largely because of the readily available water resources. The water resources are used for: domestic and industrial water supplies, irrigation and live stock watering, propagation of fish, transportation, recreation and the production of hydroelectric power. In the foreseeable future all of these water uses will become increasingly important. Of particular note are developments, now underway or planned, for irrigation, hydroelectric power, transportation, propagation of fish and domestic water supply. The chief justification for many of the reservoir developments is flood control.

Summary of Water Pollution Data

Major pollution of the Willamette and its tributaries is caused by the discharge of raw sewage from 473,650 people, treated sewage from 45,500, wastes from 6 pulp mills and a variety of other industrial plants. The total organic wastes discharged from all municipal sources of pollution has a total population of 953,800. Fifty-six industries are known to be discharging organic wastes directly to the watercourses with a population equivalent of 2,963,750. The 27 industries for which pollution data are not available are estimated to contribute only about an additional 5 percent of the total known organic waste load.

Principal pollution damages are interference with full development of the fishery, destruction of recreational areas, decreased waterfront property values, and serious impairment of present and future water supplies. Pollution conditions are most serious during periods of low stream flow which occurs in

Table A9. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	53[1]	518,650[2]	953,520[1,3]
Having population data available (Data on pollution load to watercourse incomplete or not available)	1[4]	500	Not applicable
Total	54	519,150	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Includes 4 unsewered municipalities from which septic tank effluent with an estimated PE of 14,400 escapes to watercourses through storm sewers.

[2]Does not include the population of 4 unsewered municipalities.

[3]Industrial wastes of unknown strength and volume discharged to city sewers by 9 food and 3 textile industries.

[4]No information available regarding strength and volume of wastes discharged to city sewers by 2 food industries.

late summer and early fall; the time during which wastes from seasonal food processing plants are the greatest. During this period stretches of the lower Willamette River have been found to be devoid of oxygen.

Adequate sewage treatment facilities serve less than 5 percent of the sewered population, but the present municipal pollution program includes treatment facilities to adequately serve more than 90 percent of the sewered population. The program is scheduled for completion within the next few years. This will involve the construction of new treatment plants or the enlargement of existing plants by 31 municipalities at a total estimated cost of $23,500,000. Upon completion of the municipal pollution abatement program, industrial wastes discharged to city sewers will be treated in municipal sewage treatment plants.

At present 89 industries are known to discharge wastes directly to watercourses. Of these, 35 require no additional treatment projects at this time, 26 need more suitable methods of disposal, while the requirements for the remaining 28 industries have not been determined. Five sulphite pulp mills located in the basin have been ordered to abate pollution by 1952. The estimated cost of constructing waste treatment plants at the 26 industries for which requirements have been determined is $8,120,000.

Information on sources and amounts of municipal and industrial pollution, existing treatment facilities and project requirements is presented in Tables A_9 to I_9 inclusive.

Table B_9. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	56	2,963,750
Producing organic wastes	27	Undetermined
Producing inorganic wastes	--	--
Producing wastes of undetermined type	6	Undetermined
Total	89	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_9.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	18	18	25,150
Secondary	12	12	20,350
No treatment	20**	0	473,650

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Does not include 4 unsewered communities included in Table A.

Table D_9. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.	61	36	11	14
Textile mill products.....	16	10	4	2
Paper and allied products.	6	1	5	0
Chemical and allied products.....	1	0	1	0
Miscellaneous.....	5	3	1	1
Totals.....	89	50	22	17

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_9. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	30	19	11	0	21	9	0
Industrial	50	--	1	49*	--	1	49

*Includes 35 industrial waste treatment plants which are known to be providing adequate treatment at this time and 8 plants which are known to need a higher degree of treatment although the adequacy of the capacity of existing units is undetermined. This information is reflected in the tabulation of needs under Table G_9.

Table F_9. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	0	Unknown	--
1947	1	1,000	Unknown	--
1948	4	11,050	Unknown	--
1949	7	20,600	Unknown	--

Table G_9. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	35[1]	508,750	18
Enlargement or additions to existing plant	2	8,000	5
Replace existing plant	9	15,600	3
No project required	19	21,900	35[2]
Undetermined	0	0	28

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 15 unsewered municipalities with a total population of 35,100 requiring both sewer systems and treatment plants.

[2]These industrial waste treatment plants, although appearing in Table E_9 as undetermined as to adequacy of capacity, at present require no additions to their existing treatment works.

Table H_9. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	3	--
Abatement ordered	--	5
Plans under preparation	10	--
Final plans approved	15	--
Construction awaiting financing	--	--
Under construction	3	--
Status undetermined	15	49*

*Includes 28 industries appearing in Table G for which treatment needs are undetermined.

Table I9. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served **	Project requirements	Remarks
Portland	294,000	New plant	Primary treatment
Salem	56,000	New plant	Primary treatment
Eugene	40,000	New plant	Secondary treatment
Corvallis	20,000	New plant	Primary treatment
Albany	12,000	New plant	Secondary treatment
Springfield	10,000	New plant	Secondary treatment
Oregon City	8,000	New plant	Primary treatment
Lebanon	6,000	New plant	Secondary treatment
Milwaukie	6,000	New plant	Primary treatment
Cottage Grove	5,000	New plant	Primary treatment
McMinnville	5,000	New plant	Secondary treatment
Oswego	3,000	New plant	Primary treatment
West Linn	2,500	New plant	Primary treatment
Gladstone	2,000	New plant	Primary treatment
Independence	1,500	New plant	Primary treatment
Harrisburg	950	New plant	Secondary treatment
Brownsville	500	New plant	Secondary treatment
Sheridan	500	New plant	Secondary treatment
Molalla	400	New plant	Primary treatment
Monroe	300	New plant	Sewer system and primary treatment
Multnomah	10,000	New plant	Sewer system and primary treatment
Oak Grove	5,000	New plant	Sewer system and primary treatment
Stayton	3,000	New plant	Sewer system and primary treatment
Canby	2,000	New plant	Sewer system and secondary treatment
Cornelius	2,000	New plant	Sewer system and primary treatment
Oak Ridge	2,000	New plant	Sewer system and secondary treatment
Willamina	2,000	New plant	Sewer system and secondary treatment
Mill City	1,500	New plant	Sewer system and secondary treatment
Philomath	1,500	New plant	Sewer system and secondary treatment
Sandy	1,500	New plant	Sewer system and secondary treatment
Dayton	1,400	New plant	Sewer system and primary treatment
Dunthorpe	1,000	New plant	Sewer system and secondary treatment
Tigard	1,000	New plant	Sewer system and secondary treatment
Yamhill	700	New plant	Sewer system and secondary treatment
Woodburn School	500	New plant	Secondary treatment
Hillsboro	5,000	(Enlargement of existing plant required)	Secondary treatment
Gresham	3,000	Replacement present plant	Secondary treatment
Forest Grove	4,000	Replacement present plant	Secondary treatment
Dallas	5,000	Replacement present plant	Secondary treatment

See footnotes at end of table.

Table I9. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Woodburn	2,000	Replacement present plant	Secondary treatment
Monmouth	1,500	Replacement present plant	Primary treatment
Mt. Angel	1,500	Replacement present plant	Secondary treatment
Carlton	650	Replacement present plant	Secondary treatment
Sherwood	500	Replacement present plant	Secondary treatment
Vermont Hills	350	Replacement present plant	Secondary treatment
Scio	100	Replacement present plant	Secondary treatment
McKenzie Meat Co.	250	New plant[1]	Organic wastes
Borden Co.	1,000	New plant[1]	Organic wastes
Nebergal Meat Co.	5,600	New plant[1]	Organic wastes
Reid-Murdock Cannery	32,500	New plant[1]	Organic wastes
Oregon Pulp and Paper Co.	860,000	New plant[1]	Organic wastes
State Pen. Flax Pl.	12,500	New plant[1]	Organic wastes
Spaulding Pulp and Paper Co.	495,000	New plant[1]	Organic wastes
Crown Willamette	831,000	New plant[1]	Organic wastes
Publisher Paper Co.	556,000	New plant[1]	Organic wastes
Pacific Roofing Co.	2,800	New plant[1]	Organic wastes
Volney Felt Mills	6,000	New plant[1]	Organic wastes
Brownsville Woolen Mills	Unknown	New plant[1]	Organic wastes
Steen Bros. Slaughterhouse	1,000	New plant[1]	Organic wastes
Crown Willamette Co.	109,000	New plant[1]	Organic wastes
Mt. Angel Flax Growers Association	6,000	New plant[1]	Organic wastes
Fulton Park Dairy	Unknown	New plant[1]	Organic wastes
Alpenrose Dairy	Unknown	New plant[1]	Organic wastes
Gresham Berry Growers	3,000	New plant[1]	Organic wastes
Oregon Turkey Growers	3,600	Enlargement of existing plant[1]	Septic tank
Mayberry and Chapman Meat Co.	0	Enlargement of existing plant[1]	Septic tank and land disposal
Irish McBroom Meat Co.	0	Enlargement of existing plant[1]	Septic tank - sand filter and land disposal
J. G. McKillip Slaughterhouse	0	Enlargement of existing plant[1]	Septic tank and land disposal
Benton County Flax Growers	Unknown	Enlargement of existing plant[1]	Lagoon
Eugene Chemical Works	1,000	Replacement existing plant	---
Oregon Mushroom Co.	0	Replacement existing plant	---
General Foods, Inc.	35,000	Replacement existing plant	---

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.
**Figures shown for industries represent population equivalents.
[1]Treatment or process change to be determined by industry.

COLUMBIA RIVER SUB-BASIN BELOW YAKIMA RIVER

Description and Economic Development

This area exclusive of the Snake and the Willamette River sub-basins, includes all of the drainage into the Columbia River between the mouth of the Yakima River and the Coast. It comprises 8,310 square miles in Washington, 25,960 square miles in Oregon and about 430 square miles, surface area, of Columbia River. Land elevations in this area are more variable than in other Columbia River sub-basins. Elevations vary from near sea level at the Coast to 14,404 feet, the elevation of Mt. Rainier, which is on the sub-basin divide. Mt. Adams and Mt. St. Helens in Washington, and Mt. Hood in Oregon are entirely within the sub-basin. Generally, the terrain on either side of the Columbia River rises to high elevations in a series of nearly vertical cliffs and varying width benches. Above these benches the mountains rise sharply. The Columbia River enters the sub-basin at mile station 334 and flows south and then westerly to the ocean. Through the Cascade Mountain Range it has cut a picturesque channel known as the Columbia Gorge. It is in this stretch that the might of the Columbia River becomes apparent. Along its lower basin shores floods have been most severe. The estimated 1947 population of the basin was 550,350.

The Columbia River is the most important natural resource of this sub-basin. The extensive use made of the other natural resources--agricultural lands, forests, minerals and fish--is dependent upon the Columbia River as are the resource developments in many of the up-river sub-basins. The sub-basin's chief industries--farming, lumbering, manufacturing, waterborne commerce, power production and extensive fisheries--are dependent upon the Columbia River. The potential development of this river is unequaled by any other large river within the United States. Natural resources from surrounding areas are processed in the sub-basin.

About one-half of the area is forested, of which the greater portion contains stands of saw timber. Lumber production has averaged over 800 million board feet annually since 1941.

Agriculture is diversified, ranging from cattle and sheep raising on the range lands east of the Cascades to truck gardening, fruit growing and dairying in the lower valley near centers of population. Wheat and other small grains are grown in the dry-farmed areas east of the Cascades.

Minerals occur throughout the basin, but mining activities are centered principally in the southeastern section in Oregon where gold, silver, copper, lead and mercury are mined. Manufacturing consists principally of processing woods, foods, metals and textiles. Plants of note are four pulp mills with a combined capacity of 1,860 tons of pulp per day and three aluminum reduction mills. These reduction mills represent nearly 30% of the nation's primary aluminum capacity.

Recreational opportunity in the lower Columbia drainage area is diversified and great. This area, rich in natural beauty, attracts many visitors. Fishing, hunting, picnicking, boating, camping, swimming, mountain climbing and winter sports are readily available to all the people living in the sub-basin and surrounding areas. People from all over the world are attracted to the area by the famous Astoria and other Columbia River salmon fishing derbies, the winter sports at Timberline Lodge and Government Camp recreation areas at Columbia Gorge and the many other activities along the Columbia River. Obviously the recreational income is as important as the income from other major industrial activities.

Waterborne commerce and commercial fishing, both of which depend entirely upon use of the Columbia River, are of great economic importance.

Uses of Water Resources

Because of the Columbia River and its tributaries the water resources in this sub-basin are more than adequate. They supply the domestic needs of over 173,300 people living in the sub-basin and over 400,000 people living in the Portland area, are used to irrigate approximately 300,000 acres of land and provide industries with necessary process waters.

Columbia River salmon and steelhead trout, valued at 17.5 million dollars annually, use the lower river and its tributaries for spawning. One of these tributaries, the Cowlitz River, has been declared a fisheries reserve by the Washington Legislature. Across the sub-basin and up and down the Columbia are important migratory water fowl routes.

Navigation on the Columbia River and some of its tributaries is of great importance to the sub-basin's economy. Ocean-going vessels transport commodities up and down the river to Vancouver, Wash. Barge transportation between Portland-Vancouver and Pasco, Wash.

is firmly established. During 1946 a total of 1,191 in-bound and 1,081 out-bound vessels constituted the ocean carrier traffic on the Columbia. This represented an in-bound tonnage of 4,739,083 and an out-bound tonnage of 2,142,885. During 1947 a total of 1,265,003 tons of commodities passed through Bonneville Dam Locks in both upstream and downstream traffic.

From an economic standpoint, probably the greatest use of Columbia River is for development of hydroelectric power. Bonneville Dam, located on the Columbia about 35 miles above Portland, is the first great project completed on the Columbia River. McNary Dam now unde construction and others planned for early development will provide much needed hydroelectric power for the entire Pacific Northwest In addition these developments will provide for more extensive upstream navigation and will permit the irrigation of additional lands.

Summary of Water Pollution Data

If it were not for the Columbia River's abundant waters, pollution in the basin would be severe. Some 48 municipalities, with a total sewered population of approximately 281,000, discharge raw and partially treated wastes with a population equivalent of over 369,000. Although the amount and strength of the organic wastes being discharged directly to the watercourses has been determined at only 15 of the 119 industries in the sub-basin using separate outlets, these known organic wastes have a total population equivalent of 1,600,000. In addition, the heavily polluted Willamette River discharges into the lower Columbia River.

Municipalities and industries located on tributaries of the Columbia, east of the Cascades, do not have available water in the amounts necessary to provide for adequate dilution of the wastes produced. This is especially true in the heavy food processing area near Pendleton, Oreg. and Walla Walla, Wash. Several large industries located on Columbia Slough adjacent to Portland and on small tributaries adjacent to centers of population in the area west of the Cascades also cause serious pollution. These are the principal critical pollutional areas in the lower Columbia River sub-basin.

Even with its great flow, however, it has been necessary for Pasco and Kennewick, Wash. to install filtration plants for treatment of Columbia River water. Bacterial contamination has been found in this water at other domestic water supply sources downstream. Several of the larger industries, such as the pulp mill at Longview, have had to install filtration plants for the treatment of process waters. Wastes from pulp mills located along the Columbia cause Sphaerotilus growths which collect on and damage the nets used by the commercial fishermen.

The possibility that radioactive wastes discharged into the Columbia River by the Hanford Atomic Energy Plant may affect downstream water uses needs further investigation.

Sewage treatment facilities have been installed by 30 municipalities located, mainly, on tributaries of the Columbia River. These serve about 35 percent of the total sewered population. Only 13 of the 119 industrial plants discharging wastes directly to watercourses are known to have treatment facilities. One of these is a magnesium base recovery plant for sulphite liquor from a pulp mill- the first constructed in the United States. This plant, constructed by the Weyerhaeuser Timber Company at Longview, Wash. is recovering most of the wastes from a 250 tons per day pulp mill. No determination has been made of

Table A_{10}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	40	213,042	331,331[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	8[2]	37,748[3]	Not applicable
Total	48	250,790	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers; and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strength and volume discharged to city sewers by 14 food industries.

[2]No information is available regarding strength and volume of wastes discharged to city sewers by 25 food industries.

[3]Sewered population of 1 municipality not available.

the treatment facilities, if any, in use at 104 industries. Eighteen of the municipal and 9 of the industrial waste treatment facilities are adequate in capacity and are operated satisfactorily.

Known waste treatment plant requirements include 23 new municipal sewage treatment plants and 14 new industrial waste treatment plants, enlargements to 6 municipal treatment plants and the replacement of 7 existing municipal plants with modern type treatment facilities. Sixteen municipalities and 12 industries do not require additional treatment facilities. The estimated cost of constructing the municipal plants if $5,298,000. The estimated cost of the industrial facilities is $3,100,000.

Twelve of the municipalities have plans under preparation, 3 have completed final plans for treatment facilities and 4 plants are now under construction.

Information on sources and amounts of pollution, existing treatment facilities and project requirements is presented in Tables A_{10} to I_{10} inclusive.

Table B_{10}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	15	1,605,411
Producing organic wastes	81	Undetermined
Producing inorganic wastes	12	Not applicable
Producing wastes of undetermined type	11	Undetermined
Total	119	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{10}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	13	12[1]	44,895
Secondary	17[2]	16[3]	42,560
No treatment	18	0	163,335

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

[1]Pendleton and State Hospital (total population 11,400) served by one plant.

[2]Sewered population of 1 municipality not available.

[3]Milton and Freewater (total population 3,000) served by 1 plant.

Table D_{10}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	85	11	1	73
Paper and allied products..	10	2	1	7
Lumber and wood products...	7	--	--	7
Primary metal industries...	3	--	--	3
Chemical and allied products.....	3	--	--	3
Textile mill products.....	1	--	--	1
Fabricated metal products..	4	--	--	4
Products of petroleum and coal.....	2	--	--	2
Furniture and fixtures.....	1	--	--	1
Miscellaneous.....	3	--	--	3
Totals.....	119	13	2	104

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{10}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	28	18	10	0	18	10	0
Industrial	13	9	--	4	9	--	4

Table F_{10}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	2	6,500	Unknown	--
1948	2	3,500	1*	30,000
1949	3	42,700	1*	1,000,000

*Information regarding construction of other industrial waste treatment facilities not available.

Table G_{10}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant[1]	23	158,933	14
Enlargement or additions to existing plant	6	41,430	--
Replace existing plant	7[3]	7,300	--
No project required	16[4]	48,725[2]	12
Undetermined	0	0	93

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 6 unsewered municipalities with a total population of 5,598 requiring both sewer systems and treatment plants.

[2]Sewered population of 1 municipality not available.

[3]Includes 3 municipal treatment plants appearing in Table E_{10} as having adequate capacity. Though the capacity of existing units is adequate, a higher degree of treatment is required.

[4]Includes 1 municipality having no treatment facilities.

Table H_{10}. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	17	2
Abatement ordered	0	11
Plans under preparation	12	--
Final plans approved	3	--
Construction awaiting financing	0	--
Under construction	4	--
Status undetermined*	0	94

*Includes 93 industries appearing in Table G for which treatment needs are undetermined.

Table I_{10}. Project list - municipalities and industries requiring improvements for abatement of pollution* July 1, 1950

Name	Population served**	Project requirements	Remarks
Portland, Oreg.....	100,000	New plant	Primary treatment (under construction)
Longview, Wash.....	12,000	New plant	Primary treatment
Pasco, Wash.....	8,260	New plant	Primary treatment
The Dalles, Oreg.....	6,000	New plant	Primary treatment
Kelso, Wash.....	5,454	New plant	Sewer extensions and primary treatment
Camas, Wash.....	5,200	New plant	Primary treatment
Kennewick, Wash.....	5,100	New plant	Primary treatment
St. Helens, Oreg.....	3,500	New plant	Primary treatment
Hood River, Oreg.....	3,000	New plant	Primary treatment
Sandy, Oreg.....	1,500	New plant	Sewer system and secondary treatment
Woodland. Wash.....	1,170	New plant	Primary treatment (under construction)
Kalama, Wash.....	1,050	New plant	Sewer system and primary treatment
Rainier, Oreg.....	1,000	New plant	Primary treatment
Ilwaco, Wash.....	950	New plant	Primary treatment
Binger, Wash.....	746	New plant	Sewer system and primary treatment
Cathlamet, Wash.....	621	New plant	Sewer system and primary treatment
Toledo, Wash.....	600	New plant	Sewer system and primary treatment
Arlington, Oreg.....	600	New plant	Primary treatment
Fossil, Oreg.....	532	New plant	Sewer system and secondary treatment
Clatskanie, Oreg.....	500	New plant	Primary treatment
Stevenson, Wash.....	500	New plant	Primary treatment
Vader, Wash.....	400	New plant	Secondary treatment needed
Castle Rock, Wash.....	250	New plant	Sewer system and primary treatment
Walla Walla, Wash.....	24,000	Enlargements	Secondary treatment
Pendleton, Oreg.....	10,000	Additions	Secondary treatment (under construction)
State Hospital, Oreg.....	1,400	Additions	To be treated by Pendleton plant
Dayton, Wash.....	3,200	Additions	Grit chamber and heat for digester
Prineville, Oreg.....	2,000	Enlargements	Secondary treatment
Klickitat, Wash.....	830	Addition	Secondary treatment needed
Hermiston, Oreg.....	2,000	Replace existing plant	Secondary treatment
Penitentiary, Wash.....	1,672	Replace existing plant	To be served by Walla Walla
Winlock, Wash.....	1,148	Replace existing plant	Secondary treatment
Bend, Oreg.....	1,000	Replace existing plant	Primary treatment
Waitsburg, Wash.....	680	Replace existing plant	Secondary treatment needed
Condon, Oreg.....	600	Replace existing plant	Secondary treatment required
Maupin, Oreg.....	200	Replace existing plant	Secondary treatment
Crown Zellerbach Corp. (Camas) Wash.....	1,100,000	New plant	Sulfite pulp liquor. Disposal by diffusion pipe main stem Columbia
Clark County Dairymen Ass'n, Battleground, Wash.....	N	New plant[1]	Organic wastes
Swift & Co., (Oregon Slough)..	N	New plant[1]	Organic wastes

See footnotes at end of table.

Table I_{10}. Project list - municipalities and industries requiring improvements for abatement of pollution* July 1, 1950--Coninued

Name	Population served**	Project requirements	Remarks
Stearns & Welch Meat Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Portland Provision Co. (meat packing)	N	New plant[1]	Organic wastes
Portland Rendering Co.	N	New plant[1]	Organic wastes
Columbia Wool Scouring	N	New plant[1]	Organic wastes
Western States Rendering Co.	N	New plant[1]	Organic wastes
Pacific Meat Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Northwest Packing Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Gem Meat Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Branders Meat Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Associated Meat Co. (Columbia Slough)	N	New plant[1]	Organic wastes
Armour & Co. (Columbia Slough)	N	New plant[1]	Organic wastes

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.
**Figures given for industries represent Population Equivalents.
[1]Treatment or process change to be determined by industry.
N No data available.

PUGET SOUND SUB-BASIN

Description and Economic Development

The Puget Sound drainage sub-basin considered in this report encompasses approximately 13,281 square miles of land area draining into Puget Sound and adjoining tidal waters in northwestern Washington and southwestern British Columbia. This land area is bounded on the north by British Columbia, on the east by the Cascade Range, on the south by the Columbia and Chehalis River drainage basins and on the west by the Olympic and Coast Range mountains. Also included in the sub-basin is a water area of 2,000 square miles. Portions of the Nooksack and Skagit River drainages are in British Columbia and a part of the Fraser River drainage into British Columbia is from the State of Washington. Topographically the sub-basin is unique because of its inland waters, many islands and lowlands and high mountain peaks. Most of the mountainous area is heavily forested. Numerous rivers and streams drain from the east, south and west through canals, inlets and lakes, into Puget Sound, the Juan DeFuca Strait and other bays and straits making up the Puget Sound waters.

Estimated population of the sub-basin for 1948 was 1,247,620. Most of the population is located in the principal cities adjacent to the waters of Puget Sound.

The sub-basin's greatest resource is its extensive protected inland waterway. The many inlets, bays and canals serving an area from the Canadian line south to Olympia, Wash. make it a focal point for regional, national and world trade. Its numerous and excellent harbors provide ideal locations for a large Navy Base and numerous shipyards, all of which are important from the standpoint of national defense. These and other important resources--land, forest, minerals, and mountain-fed streams--are responsible for the basic industries of commerce, manufacturing, lumbering, agriculture, power production, mining, fishing and recreation.

Manufacturing is the sub-basin's chief industrial activity and depends upon the extractive industries of which logging is the most important. Agriculture, mining and commercial fishing are other extractive industries of considerable importance to the basins' economy.

Uses of Water Resources

This region has valuable water power resources of which only a small part has been developed. Abundant water is available for all industrial and domestic needs. Forty-eight communities serving an estimated population of over 772,000 obtain all or most of their water supplies from these surface waters. Watercourses of the basin also support an extensive commercial and sport fishery. The area's scenic and recreational resources unexcelled in variety and beauty. Recreational facilities exist on scale sufficient not only to provide for all the recreational needs of the local population but to provide attractive playgrounds for millions of visitors annually. The 2,000 miles of forest-lined beaches are ideal for picnicking, bathing and clam digging. The climate is so mild that pleasure boating and sport fishing are year-around activities. Wildlife of the region includes game animals and birds as well as a large variety of fish.

Summary of Water Pollution Data

Pollution wastes are discharged to Puget Sound and its tributaries by 96 municipalities serving an estimated population of over 908,200 and by 280 industries which discharge wastes directly to the watercourses. Although the amount and strength of industrial wastes produced have been estimated for only 29 percent of the industries, these represent the major sources of industrial pollution. The total known organic waste load discharged to basin watercourses has a population equivalent of over 6,300,000. Nearly 85 percent of this total pollution load is contributed by industry. Of particular significance are the organic wastes discharged by the pulp and paper mills located throughout Puget Sound. The greatest waste discharge of this kind comes from mills in the Everett area. Numerous primary metal industries and metal plating plants located principally in the vicinity of Seattle and Tacoma are a source of toxic and chemical wastes.

Raw or partially treated sewage is discharged at shallow depth to tidal waters by the large municipalities and is resulting in unsightly and insanitary conditions at many water fronts and beach areas. Pollution has caused appreciable depreciation in waterfront property values in the vicinity of Seattle, Tacoma and other tidal areas. The most serious of these conditions exists in the vicinity of Seattle where important beach and shellfish growing areas have been closed to the public. A real public health hazard exists in this area since the pollution warning signs that have been posted are largely ignored by those using the beaches. Pollution has also had adverse effects upon shellfish

and the commercial and sport fishery. Thousands of fish were killed from pollution in the vicinity of Everett as late as 1949. Several communities obtaining their domestic water supplies from Lake Washington, the Nooksack and Skagit Rivers have found the water quality unsatisfactory for this purpose and have had to resort to complete treatment of their supplies.

Sixteen percent of the basin's sewered population are served by sewage treatment facilities include 30 primary and 18 secondary treatment plants. Some degree of industrial waste treatment is known to be provided at 14 percent of the industries discharging wastes directly to watercourses. Most significant of industrial waste treatment facilities is the disposal by burning of the ammonia-base waste sulfite liquor at the Rayonier, Inc. pulp mill at Shelton, Wash. To this one treatment plant can be attributed the restoration of the valuable Olympia oyster industry. Twenty nine of the existing municipal treatment plants and the Shelton pulp mill treatment plant are known to have adequate capacity.

New treatment plants are known to be needed at 73 communities, serving 92 percent of the basin's present sewered population, and at 6 industries. Included as a municipality needing treatment facilities is the City of Seattle with a population of almost 500,000. Here no progress is being made towards correcting existing pollution conditions as city officials have assumed the attitude that raw sewage can be discharged into the waters of Puget Sound without treatment. It is the opinion of the Washington Pollution Control Commission that this attitude is the largest single hindrance to the pollution control program in the State of Washington. Enlargements or additions are needed at 7 municipal treatment plants. The replacement of 10 existing municipal plants is also needed. Treatment requirements for one municipality and 272 industries have not been determined.

Abatement of pollution by 2 large sulphite pulp mills has been ordered. Twenty-three municipalities have sewage treatment plant plans under preparation and 2 have final plans approved. Construction of 7 municipal treatment plants is awaiting financing and 13 have plants under construction. The estimated cost for construction of the needed municipal treatment projects is $42,000,000. The industrial waste treatment projects needed at 6 sulphite pulp mills are estimated to cost about $13,000,000.

Information on sources and amounts of pollution, existing treatment facilities and project requirements are shown in Tables A_{11} to I_{11} inclusive.

Table A_{11}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	88[1]	900,019[2]	956,576[1,3]
Having population data available (Data on pollution load to watercourse incomplete or not available)	8[4]	8,220	Not applicable
Total	96	908,239	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Includes 4 unsewered municipalities from which septic tank effluents, with an estimated P.E. of 5585, seeps to watercourse.

[2]Does not include population of 4 unsewered municipalities.

[3]Industrial wastes of unknown strength and volume discharged to city sewers by 48 food industries and 27 toxic waste producing industries, not included.

[4]No information is available regarding strength and volume of wastes discharged to city sewers by 4 food industries. Sewered population of 6 municipalities not available.

Table B_{11}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	80	5,414,324
Producing organic wastes	145	Undetermined
Producing inorganic wastes	35	Not applicable
Producing wastes of undetermined type	20	Undetermined
Total	280	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{11}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	30	30	99,097[2]
Secondary	18	18	47,467[3]
No treatment	45[1]	0	761,675[4]

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

[1]Seattle is also included in the "primary treatment" category since a relatively small portion of the sewered population is served by a primary treatment plant. Total number of sewered communities is, therefore, 92.

[2]Sewered population of 3 municipalities not available.

[3]Sewered population of 1 municipality not available.

[4]Sewered population of 2 municipalities not available.

Table D_{11}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products...	188	13	40	135
Lumber & mill products....	28	3	15	10
Products of petroleum and coal.....	7	6	1	0
Fabricated metal products.	3	1	2	0
Paper & allied products...	15	5	8	2
Ship & boat building.....	3	1	2	0
Chemicals & allied products.....	7	2	3	2
Rolling, steel.....	1	0	1	0
Motor vehicles.....	1	1	0	0
Aircraft.....	2	0	2	0
Machinery.....	1	0	1	0
Stone, glass and clay products.....	2	1	0	1
Metal plating.....	3	0	0	3
Primary metal industries..	1	0	0	1
Miscellaneous.....	1	0	0	1
Non-mettalic mining and quarrying.....	5	1	0	4
Mining, bituminous coal...	9	1	0	8
Railroad servicing.....	3	3	0	0
Totals.....	280	38	75	167

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{11}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	48	29	12	7*	33	8	7
Industrial	38	1	--	37	1	--	37

*Includes 6 municipal plants which are known to require a higher degree of treatment although the capacity of existing units is undetermined. These needs are reflected in Table G_{11}.

Table F_{11}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	1,500	Unknown	--
1947	2	4,000	Unknown	--
1948	4	14,320	Unknown	--
1949	2	41,000	Unknown	--

Table G_{11}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant[1]	73	836,099	6
Enlargement or additions to existing plant	7	16,747	--
Replace existing plant	10	10,422	--
No project required	30	111,320	2
Undetermined	1	75	272

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 28 unsewered communities with a total population of 74,424 requiring both sewer systems and treatment plants. Seattle is also included under "No Project Required" since a small portion of the sewered population is served by an adequate treatment facility.

Table H_{11}. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	55	4
Abatement ordered	--	2
Plans under preparation	23	--
Final plans approved	2	--
Construction awaiting financing	7	--
Under construction	3	--
Status undetermined*	1	272

*Includes 1 municipality and 272 industries appearing in Table G for which treatment needs are undetermined.

Table I_{11}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Seattle	410,000	New plants	Primary treatment
Tacoma	100,000	New plants	Primary treatment
Fort Lewis	100,000	New plants	Primary treatment
S.W.Suburban Sewer District	50,000	New plants	Sewer system and primary treatment
Bremerton	33,000	New plants	Primary treatment
Everett	32,550	New plants	Primary treatment
Port Angeles	17,000	New plants	Primary treatment
Olympia	16,500	New plants	Primary treatment
Puyallup	7,720	New plants	Primary treatment
Anacortes	5,200	New plants	Sewer extensions and primary treatment
Birch Bay	5,000	New plants	Sewer system and primary treatment
Port Townsend	4,000	New plants	Primary treatment
Bellevue Sewer District	4,000	New plants	Sewer system and secondary treatment
Shelton	3,680	New plants	Primary treatment
W. Washington State Hospital	3,219	New plants	Primary treatment
Snohomish	3,116	New plants	Primary treatment
Bryn Mawr-Lake Ridge Sewer D.	3,000	New plants	Sewer system and secondary treatment
Sumner	2,800	New plants	Primary treatment with chemical precipitation
White Center	2,800	New plants	Will be absorbed by S.W. Suburban Sewer District
Richmond Beach	2,250	New plants	Primary treatment
Marysville	2,000	New plants	Primary treatment
Edmonds	1,700	New plants	Primary treatment
Port Orchard	1,300	New plants	Primary treatment
Three Points Sewer District	1,250	New plants	Sewer system and secondary treatment
Monroe	1,200	New plants	Primary treatment
Buckley	1,200	New plants	Secondary treatment
Tumwater	1,186	New plants	Sewer system and joint treatment with Olympia
Fircrest	1,117	New plant	Treatment through Tacoma Plant
Bothel	959	New plant	Sewer system and secondary treatment
Arlington	900	New plant	Sewer extensions and primary treatment
Darrington	855	New plant	Sewer system and secondary treatment
Redmond	850	New plant	Sewer system and secondary treatment
Ruston	842	New plant	Primary treatment
Concrete	830	New plant	Sewer system and primary treatment
Gig Harbor	818	New plant	Sewer system and primary treatment
Mukilteo	813	New plant	Sewer system and primary treatment
Blaine	751	New plant	Primary treatment
North Bend	740	New plant	Sewer system and primary treatment
Friday Harbor	700	New plant	Primary treatment

See footnotes at end of table

Table I_{11}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Granite Falls	700	New plant	Primary treatment
Retsil	700	New plant	Primary treatment
Sequim	700	New plant	Primary treatment
Steilacoom	600	New plant	Primary treatment
Skykomish	507	New plant	Sewer system and primary treatment
Port Gamble	500	New plant	Primary treatment
Silverdale	500	New plant	Primary treatment
Sumas	500	New plant	Secondary treatment
Carbonada	450	New plant	Primary treatment
Lyman	450	New plant	Sewer system and treatment type undetermined
Tolt	450	New plant	Sewer system and primary treatment
Sultan	445	New plant	Sewer extensions and primary treatment
Fall City	400	New plant	Sewer system and primary treatment
Gold Bar	331	New plant	Sewer system and treatment-type undetermined
Startup	300	New plant	Sewer system and treatment-type undetermined
Nooksack	300	New plant	Sewer system and secondary treatment
Marietta	250	New plant	Sewer system and primary treatment
Hamilton	250	New plant	Sewer system and treatment-type undetermined
Laconner	230	New plant	Sewer extensions and primary treatment
Blanchard	200	New plant	Sewer system and primary treatment
Duvall	200	New plant	Sewer system and primary treatment
Rockport	200	New plant	Sewer system and treatment-type undetermined
East Stanwood	185	New plant	Sewer extensions and primary treatment
Index	170	New plant	Primary treatment
Marblemount	150	New plant	Sewer system and treatment-type undetermined
Stanwood	150	New plant	Treatment through East Stanwood Plant
Bayview	135	New plant	Sewer system and primary treatment
Port Ludlow	100	New plant	Primary treatment
Everson	75	New plant	Sewer extensions and primary treatment
Langlie	75	New plant	Sewer extensions and treatment - type undetermined
Black Diamond	50	New plant	Sewer extensions and secondary treatment
Fort Ward	Undetermined	New plant	Treatment undetermined
DesMoines Sewer District	Undetermined	New plant	Primary treatment
McNeil Island Penitentiary	Undetermined	New plant	Primary treatment
Kirkland	9,500	Enlargement of existing plant	Secondary treatment

See footnotes at end of table.

Table I_{11}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Issaquah	911	Enlargement of existing plant	Secondary treatment
Skyway Housing	3,100	Additions other treatment methods	Secondary treatment
Val-vue Sewer District	1,500	Additions other treatment methods	Sewer extensions and additions to existing secondary treatment plant
Orting	1,200	Additions other treatment methods	Chlorination needed
Coupeville	386	Additions other treatment methods	Further study required
State Old Soldier's Home	150	Additions other treatment methods	Chlorination needed
Auburn	4,410	Replacement of existing 2 plants	Primary treatment
Duwamish Housing	3,650	Replacement of existing plant	Primary treatment
Kent	3,000	Replacement of existing plant	Primary treatment with chemical precipitation
Northern State Hospital	2,600	Replacement of existing plant	Secondary treatment
Sedro Woolley	1,500	Replacement of existing plant	Secondary treatment
Rainier State School	1,206	Replacement of existing plant	Secondary treatment
Snoqualmie	950	Replacement of existing plant	Sewer extensions and primary treatment
Winslow	560	Replacement of existing plant	Sewer extensions and primary treatment
Wilkeson	476	Replacement of existing plant	Sewer extensions and primary treatment
Eatonville	70	Replacement of existing plant	Sewer extensions and secondary treatment
Soundview Pulp and Paper	1,940,000	New plant[1]	Sulfite pulp liquor
Weyerhaeuser Pulp Division	1,010,000	New plant[1]	Sulfite pulp liquor
Rayonier, Inc.	746,000	New plant[1]	Sulfite pulp liquor
Coos Bay Pulp Co.	264,000	New plant[1]	Sulfite pulp liquor
Fiberboard Prod. Inc.	200,000	New plant[1]	Sulfite pulp liquor
Crown Zellerbach Pulp Co.	175,000	New plant[1]	Sulfite pulp liquor

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

**Figures given for industries represent Population equivalents.

[1]Treatment or process change to be determined by industry.

WASHINGTON COAST SUB-BASIN

Description and Economic Development

The Washington Coast Sub-Basin includes the coastal drainage of the State of Washington south of the Strait of Juan de Fuca and north of the Columbia River. It includes an area of about 6,235 square miles. The sub-basin has a north-south length of 152 miles and width varying from 39 to 80 miles. Generally speaking, the drainage area is a crescent-shaped bowl sloping from three sides to the Pacific Ocean.

Of the 46 streams whose mouths are located at tidewater, 5 empty into the Strait of Juan de Fuca, 9 into Grays Harbor, 13 into Willapa Bay, and the remainder into the Pacific Ocean. Of these only the Chehalis and Willapa Rivers are important from the standpoint of stream pollution.

The estimated 1948 population of the basin was 108,640.

Fertile lowlands, access to the ocean fisheries and huge timber resources have led to an economy developed around agriculture, lumbering, fishing and seafood processing. In addition to these industries a large pulp mill near Hoquiam and coal mines in Thurston County add to the basin's in[illegible]e.

Uses of Water Resources

The use of the waters in the [illegible] for fish and shellfish production [illegible] basin's fish and seafood processing. In addition to supporting these industries, shellfish of the area provide one of the tourist attractions. Sixty-five percent of communities in the basin derive all or part of their domestic water supply from surface sources. In addition, the water resources of the basin are used for industrial, recreational, wildlife and stockwatering purposes.

Summary of Water Pollution Data

Principal pollution of the basin's water resources is caused by the discharge of raw and partially treated wastes from 12 communities serving 53,900 people, and 4 unsewered communities from which septic tank effluents reach the watercourse. In addition to this pollution from municipal sources, industrial wastes are discharged from a pulp mill, with a population equivalent of 886,000, five other industries with a population equivalent of 4,000 and 53 industries with wastes of unknown strength and volume.

Pollutional damages are confined principally to the Chehalis and Willapa Rivers, Willapa Bay, Grays Harbor, and minor beach areas. Grays Harbor is known to be the most critical pollution area. Raw sewage from 32,500 people residing in the communities of Aberdeen and Hoquiam is discharged directly to the upper part of Grays Harbor and to estuaries of Chehalis, Wishkah and Hoquiam Rivers. This population represents approxi-

Table A_{12}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	15[1]	44,219[2]	47,161[1,3]
Having population data available (Data on pollution load to [illegible]e	1[4]	12,00	Not applicable
Total	16	56,219	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Includes 4 unsewered municipalities from which septic tank effluent with an estimated PE of 2632 seeps into watercourse.

[2]Does not include population of 4 unsewered municipalities.

[3]Industrial wastes of unknown strength & volume discharged to city sewers by 17 food industries not included.

[4]No information is available regarding strength & volume of wastes discharged to city sewers by 5 food industries and 1 paper products industry.

mately 58 percent of the total sewered population of the basin. In addition, the controlled release of sulphite waste liquor from the lagoons of the 250 ton per day Rayonier, Inc. pulp mill have affected large shellfish growing areas.

Five municipalities with approximately 13 percent of the total sewered population are served by treatment facilities. Only one of these facilities is known to be of adequate capacity. One industry is known to treat its wastes before discharge; however, the capacity of this waste treatment facility is inadequate.

Table B_{12}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	6	889,970
Producing organic wastes	50	Undetermined.
Producing inorganic wastes	3	Not applicable.
Producing wastes of undetermined type	-	Undetermined.
Total	59	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Known waste treatment requirements include 11 new municipal waste treatment plants and the enlargement or additions to 2 municipal and one industrial treatment plant. At present, one municipal waste treatment plant is under construction and plans are being prepared by 10 other municipalities. The total estimated cost for municipal projects is $2,500,000. The cost for enlargement of the one industrial waste treatment plant is estimated to be $500,000. Three municipalities, serving 5,750 people, do not require treatment projects. The treatment needs of one municipality and 58 industries have not been determined.

Information on sources and amounts of pollution, existing treatment facilities, and project requirements is presented in Tables A_{12} to I_{12} inclusive.

Table C_{12}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	3	3	1,650
Secondary	2	2	5,463
No treatment	7	0	49,106

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_{12}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food & kindred products...	55	--	2	53
Paper & allied products...	1	1	0	0
Bituminous & other soft coal.....	3	--	--	3

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{12}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	5	1	3	1	4	0	1
Industrial	1	0	1	0	1	0	0

Table F_{12}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	1	6500	Unknown	--

Table G_{12}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	11[1]	52,434	-
Enlargement or additions to existing plant	2	1,363	1
Replace existing plant	0	0	-
No project required	3[2]	5,750	-
Undetermined	1	200	58

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 5 unsewered municipalities with a total population of 3528 requiring both sewer systems and treatment plants.

[2]Includes two municipal treatment plants shown in Table E as unsatisfactory. These are small and require no project at this time.

Table H_{12}. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	2	-
Abatement ordered	-	1
Plans under preparation	10	-
Final plans approved	-	-
Construction awaiting financing	-	-
Under construction	1	-
Status undetermined*	1	58

*Includes 1 municipality and 58 industries appearing in Table G for which treatment needs are undetermined.

Table I_{12}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
Aberdeen, Wash.....	20,500	New plant	Sewer system extension and Primary treatment
Hoquiam, Wash.....	12,000	New plant	Sewer system extensions and Primary treatment
Centralia, Wash.....	8,000	New plant	Secondary treatment (under construction)
Raymond, Wash.....	3,400	New plant	Primary treatment
Montesano, Wash.....	2,280	New plant	Primary treatment
South Bend, Wash.....	2,026	New plant	Primary treatment
Tenino, Wash.....	1,182	New plant	Sewer system and secondary treatment
Cosmopolis, Wash.....	900	New plant	Primary treatment
Westport, Wash.....	896	New plant	Sewer system and primary treatment
Long Beach, Wash.....	850	New plant	(Sewer system and secondary
Seaview, Wash.....	400	New plant	(treatment- one plant
Elma, Wash.....	900	Additions	Secondary treatment
Pacific Beach, Wash.....	463	Plant enlargements	Secondary treatment
Clallam Bay, Wash.....	200	Undetermined	
Rayonier, Inc.....	886,000	Enlargements	Enlargement of storage lagoon

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.
**Figures given for industries represent Population Equivalents.

plants with modern type facilities. The estimated cost of constructing the municipal treatment facilities, including intercepting sewers and complete sewerage systems for unsewered communities is $4,244,000. The estimated cost of the enlargement of the one industrial treatment plant is $25,000. No projects are required for 15 municipalities and 8 industries located in the sub-basin. Requirements for 31 industries are undetermined.

Information on sources and amounts of pollution, treatment facilities and project requirements is shown in Tables A_{13} to I_{13} inclusive.

Table A_{13}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	41[1]	73,195[2]	47,605[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	5[3]	3,500[4]	Not applicable
Total	46	76,695	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Includes 8 unsewered municipalities from which septic tank effluent with an estimated P.E. of 6,475 seeps into watercourse.

[2]Does not include population 8 unsewered municipalities.

[3]No information is available regarding strength and volume of waste discharged to city sewers by 5 food industries.

[4]Does not include population of 4 unsewered municipalities from which septic tank effluent in unknown quantity seeps to watercourse.

Table B_{13}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	1	210,000
Producing organic wastes	37	Undetermined
Producing inorganic wastes	1	Not applicable
Producing wastes of undetermined type	1	Undetermined
Total	40	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{13}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	11	11	17,370
Secondary	6	5	34,000
No treatment	17	0	25,325

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_{13}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.....	37	2	15	20
Paper and allied products.....	1	0	1	0
Railroad servicing.....	1	1	0	0
Lumber and wood products.....	1	0	0	1

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{13}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	16	9	5	2*	9	5	2
Industrial	3	--	2	1	--	2	1

*These 2 municipal treatment plants are known to require a higher degree of treatment although the capacity of existing units is undetermined. These needs are reflected in Table G_{13}.

Table F_{13}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	Unknown	--
1947	0	--	Unknown	--
1948	0	--	Unknown	--
1949	2*	45,000	Unknown	--

*Includes sewage treatment plant of abandoned military installation now serving two communities.

Table G_{13}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	24[1]	39,101	0
Enlargement or additions to existing plant	4	22,000	1
Replace existing plant	3	1,620	0
No project required	15[2]	29,300	8
Undetermined	0	0	31

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

[1]Includes 10 unsewered municipalities with a total population of 15,201 requiring both sewer systems and treatment plants.

[2]Includes 2 unsewered municipalities with a total population of 125.

Table H_{13}. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	14	0
Abatement ordered	0	0
Plans under preparation	9	0
Final plans approved	3	0
Construction awaiting financing	2	0
Under construction	3[1]	0
Status undetermined[2]	0	32

[1]Construction started on one plant but stopped because of lack of funds.

[2]Includes 31 industries appearing in Table G for which treatment needs are undetermined.

Table I_{13}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
North Roseburg Sanitary Dist.	4,000	New plant	Sewer system and secondary treatment
Sutherlin.....	3,500	New plant	Sewer system and secondary treatment
Ocean Lake.....	2,000	New plant	Sewer system and secondary treatment
Nelscott and DeLake.....	1,000	New plant	Sewer system and secondary treatment
Rockaway.....	900	New plant	Sewer system and secondary treatment
Phoenix.....	601	New plant	Sewer system and secondary treatment
Netarts.....	400	New plant	Sewer system and secondary treatment
Riddle.....	2,000	New plant	Secondary treatment plant required. Construction started but uncompleted because of lack of funds.
Newport.....	2,000	New plant	Interceptor sewer and secondary treatment
Myrtle Point.....	1,200	New plant	Secondary treatment
Myrtle Creek.....	900	New plant	Secondary treatment

See footnote at end of table.

Table I_{13}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served	Project requirements	Remarks
Drain	500	New plant	Secondary treatment
Taft	1,000	New plant	Sewer system and primary treatment
Waldport	1,000	New plant	Sewer system and primary treatment
Gold Beach	800	New plant	Sewer system and primary treatment
Coos Bay	5,000	New plant	Primary treatment
North Bend	4,000	New plant	Primary treatment
Coquille	3,500	New plant	Primary treatment
Toledo	2,000	New plant	Primary treatment
Reedsport	1,500	New plant	Primary treatment
Florence	500	New plant	Primary treatment
Empire	400	New plant	Primary treatment
Nehalem	200	New plant	Primary treatment
Wheeler	200	New plant	Primary treatment
Grants Pass	8,000	Enlargement to existing plant	Primary treatment
Ashland	7,500	Enlargement to existing plant	Secondary treatment
Roseburg	6,000	Enlargement to existing plant	Secondary treatment
Oregon American Lumber Company	500	Enlargement to existing plant	Primary treatment
Vernonia	1,000	Replace existing plant	Secondary treatment
Glendale	500	Replace existing plant	Secondary treatment
Siletz	120	Replace existing plant	Primary treatment
Tillamook County Creamery Assn.	N	Enlargement to existing plant	Secondary treatment

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.
N No data available.

SOUTHERN OREGON LAKES SUB-BASIN

Description and Economic Development

The Southern Oregon Lakes Sub-Basin covers an area of 18,400 square miles located entirely in Oregon south of the Columbia River drainage system. It is bounded on the west by the Klamath River Sub-Basin which drains to the Pacific Ocean off California. The sub-basin runoff drains into numerous natural lakes located at low elevations from which the water is lost largely by evaporation. The area consists of high desert plateaus, rolling sagebrush lands and rocky mountains with occasional stream valleys and lake beds. The plateau areas range in elevation from 4,000 to 6,000 feet. The 1947 population of the sub-basin was estimated at about 7,500.

Natural resources of the sub-basin are extremely limited. The entire industrial activity centers around two small sawmills and one small creamery. Minerals occur in the sub-basin, but are not mined to any great extent. The principal agricultural activity is the raising of livestock. Winter stock-feed is raised on irrigated areas and there is also a limited amount of dry farming.

Table A_{14}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	2	2,500	620[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	0	Not applicable
Total	2	2,500	--

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

**Includes industrial wastes discharged into municipal sewerage systems.

[1]Industrial wastes of unknown strength and volume discharged to city sewers by 1 food industry not included.

Uses of Water Resources

The water resources of the sub-basin are used for irrigation of the lowlands adjacent to the lakes, stockwatering and recreation. All communities in the sub-basin obtain their domestic water supplies from ground water.

The two sewered communities in the sub-basin both have treatment plants. Although one of these plants is inadequate, it serves a very small population and is not presently required to enlarge its plant.

Information on sources of pollution and existing treatment facilities is shown in Tables A_{14} to I_{14} inclusive.

Table B_{14}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	0	0
Producing organic wastes	0	0
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	0	0
Total	0	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{14}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	1	1	200
Secondary	1	1	2,300
No treatment	0	0	0

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers, and industries discharging sanitary sewage wastes directly to watercourse.

Table D_{14}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
None.....	--	--	--	--

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{14}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	2	1	1*	0	1	1	0
Industrial	0	0	0	0	0	0	0

*Although plant is of inadequate capacity the population served is very small and no project requirements are needed at present.

Table F_{14}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	0	--
1947	0	--	0	--
1948	0	--	0	--
1949	0	--	0	--

Table G_{14}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number	Population served by facilities	Number
New plant	0	--	0
Enlargement or additions to existing plant	0	--	0
Replace existing plant	0	--	0
No project required	2	2,500	0
Undetermined	0	0	0

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

Table H_{14}. Status of treatment works project to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	0	0
Abatement ordered	0	0
Plans under preparation	0	0
Final plans approved	0	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	0	0

Table I_{14}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served	Project requirements	Remarks
None.....	--	--	--

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

U. S. GOVERNMENT PRINTING OFFICE : O—1951